

SEARCH REQUEST FORM

Scientific and Technical Information Center

Requester's Full Name: BEN SACKETT Examiner #: 73489 Date: 11/17/04
 Art Unit: 1626 Phone Number 302-0704 Serial Number: 101645429
 Mail Box and Bldg/Rm Location: REM 5B31 Results Format Preferred (circle): PAPER DISK E-MAIL

If more than one search is submitted, please prioritize searches in order of need.

Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc, if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention: Two-Stage process for the hydrogenation of Maleic acid to
 Inventors (please provide full names): Robert Heppel et al.

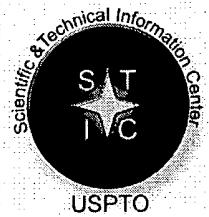
Earliest Priority Filing Date: 8/29/00

For Sequence Searches Only Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.

A process for the hydrogenation of Maleic acid to gamma-butyrolactone, 1,4-butanediol and tetrahydrofuran comprising applying a feed stream of Maleic acid into a first hydrogenation zone in the presence of a catalyst to produce succinic acid then to a 2nd hydrogenation zone in the presence of hydrogen and catalyst to produce the product stream of gamma-butyrolactone, 1,4-butanediol and tetrahydrofuran.

Remarks

| STAFF USE ONLY | | Type of Search | Vendors and cost where applicable |
|------------------------------|--------------------|-----------------------|--|
| Searcher: | <u>Noble</u> | NA Sequence (#) | STN <u>623</u> |
| Searcher Phone #: | | AA Sequence (#) | Dialog |
| Searcher Location: | | Structure (#) | Questel/Orbit |
| Date Searcher Picked Up: | | Bibliographic | Dr.Link |
| Date Completed: | <u>Nov 18 2004</u> | Litigation | Lexis/Nexis |
| Searcher Prep & Review Time: | <u>30</u> | Fulltext | Sequence Systems |
| Clerical Prep Time: | | Patent Family | WWW/Internet |
| Online Time: | <u>60</u> | Other | Other (specify) |



STIC Search Report

Biotech-Chem Library

STIC Database Tracking Number: 138055

TO: Ben Sackey
Location: 5b31/5c18
Art Unit: 1626
Thursday, November 18, 2004
Case Serial Number: 10/645426

From: Noble Jarrell
Location: Biotech-Chem Library
Rem 1B71
Phone: 272-2556
Noble.jarrell@uspto.gov

Search Notes

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(FILE 'HOME' ENTERED AT 11:06:28 ON 18 NOV 2004)

FILE 'HCAPLUS' ENTERED AT 11:21:04 ON 18 NOV 2004
L1 1 US20040039213/PN }

FILE 'REGISTRY' ENTERED AT 11:21:17 ON 18 NOV 2004

FILE 'HCAPLUS' ENTERED AT 11:21:23 ON 18 NOV 2004
L2 TRA L1 1- RN : 15 TERMS

FILE 'REGISTRY' ENTERED AT 11:21:23 ON 18 NOV 2004
L3 15 SEA L2

FILE 'WPIX' ENTERED AT 11:21:28 ON 18 NOV 2004

L4 1-US20040039213/PN }

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FILE COVERS 1907 - 18 Nov 2004 VOL 141 ISS 21
FILE LAST UPDATED: 17 Nov 2004 (20041117/ED)

This file contains CAS Registry Numbers for easy and accurate substance identification.

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L1 ANSWER 1 OF 1 HCAPLUS COPYRIGHT 2004 ACS on STN
AN 2002:171834 HCAPLUS
DN 136:217182
ED Entered STN: 08 Mar 2002
TI Two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone
IN Hepfer, Robert P.; Miller, Craig T.; Attig, Thomas G.; Norenberg, Gregory A.; Budge, John R.
PA The Standard Oil Company, USA
SO PCT Int. Appl., 14 pp.
CODEN: PIXXD2
DT Patent
LA English
IC ICM C07C051-36
 ICS C07C055-10; C07C029-149; C07C031-20
CC 35-2 (Chemistry of Synthetic High Polymers)
Section cross-reference(s): 23, 27, 48
FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|----|---------------|--|----------|-----------------|----------|
| PI | WO 2002018316 | A2 | 20020307 | WO 2001-US26765 | 20010827 |
| | WO 2002018316 | A3 | 20020620 | | |
| | W: | AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM | | | |
| | RW: | GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG | | | |
| | AU 2001085320 | A5 | 20020313 | AU 2001-85320 | 20010827 |

| | | | | |
|--|----|----------|----------------|--------------|
| EP 1313693 | A2 | 20030528 | EP 2001-964473 | 20010827 |
| R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR | | | | |
| JP 2004507516 | T2 | 20040311 | JP 2002-523434 | 20010827 |
| US 2004039213 | A1 | 20040226 | US 2003-645429 | 20030821 <-- |
| PRAI US 2000-651526 | A | 20000829 | | |
| WO 2001-US26765 | W | 20010827 | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|---------------|-------|---|
| WO 2002018316 | ICM | C07C051-36 |
| | ICS | C07C055-10; C07C029-149; C07C031-20 |
| JP 2004507516 | FTERM | 4C037/EA02; 4C037/EA03; 4H006/AA02; 4H006/AC11; 4H006/AC41; 4H006/AC46; 4H006/BA16; 4H006/BA23; 4H006/BA24; 4H006/BA25; 4H006/BA26; 4H006/BA55; 4H006/BC10; 4H006/BC11; 4H006/BD70; 4H006/BE20; 4H006/FE11; 4H039/CA19; 4H039/CA60; 4H039/CB10; 4H039/CB40 |

US 2004039213 ECLA C07C029/149 <--

AB At least one of gamma-butyrolactone, 1,4-butanediol, and THF are prepared in a process comprising: (A) a first hydrogenation zone and a second hydrogenation zone connected in series; (B) supplying to the first hydrogenation zone a feedstream comprising maleic acid; (C) reacting in the first hydrogenation zone, the maleic acid feedstock and hydrogen in contact with a catalyst to produce a reaction product comprising succinic acid; (D) supplying to the second hydrogenation zone, the reaction product of the first hydrogenation zone; (E) reacting in the second hydrogenation zone, the reaction product from the first hydrogenation zone and hydrogen in contact with a catalyst to produce a product stream comprising at least one of gamma-butyrolactone, 1,4-butanediol, and THF, where the temperature of the feedstream comprising maleic acid and the temperature of the first hydrogenation zone are controlled such that the temperature of maleic acid in the feedstream and the first hydrogenation zone does not exceed about 130.degree..

ST butanediol manuf two stage hydrogenation maleic acid; dihydroxybutane manuf two stage hydrogenation maleic acid; THF manuf two stage hydrogenation maleic acid; butyrolactone manuf two stage hydrogenation maleic acid

IT Hydrogenation catalysts
(Pt-Group metals in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT Platinum-group metals
RL: CAT (Catalyst use); USES (Uses)
(catalysts for the hydrogenation of maleic acid into 1,4-butanediol)

IT Hydrogenation
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)
IT 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-15-5, Rhenium, uses 7440-16-6, Rhodium, uses 7440-18-8, Ruthenium, uses 7440-22-4, Silver, uses
RL: CAT (Catalyst use); USES (Uses)
(catalysts in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT 7440-44-0, Carbon, uses
RL: CAT (Catalyst use); USES (Uses)
(support; catalysts in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT 110-16-7P, Maleic acid, preparation
RL: PNU (Preparation, unclassified); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT 96-48-0P, .gamma.-Butyrolactone
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or)

IT 110-15-6P, Succinic acid, preparation
RL: PNU (Preparation, unclassified); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)

IT 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6D, Succinic acid, esters 110-16-7D, Maleic acid, esters 1333-74-0, Hydrogen, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)

(two-stage process for the hydrogenation of maleic acid into
1,4-butanediol or THF or gamma-butyrolactone)
IT 109-99-9P, Thf, preparation
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT
(Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into
1,4-butanediol or gamma-butyrolactone or)
IT 110-63-4P, 1,4-Butanediol, preparation
RL: IMF (Industrial manufacture); PREP (Preparation)
(two-stage process for the hydrogenation of maleic acid into
gamma-butyrolactone or THF or)

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STRUCTURE FILE UPDATES: 17 NOV 2004 HIGHEST RN 783276-57-3
DICTIONARY FILE UPDATES: 17 NOV 2004 HIGHEST RN 783276-57-3

TSCA INFORMATION NOW CURRENT THROUGH MAY 21, 2004

Please note that search-term pricing does apply when
conducting SmartSELECT searches.

Crossover limits have been increased. See HELP CROSSOVER for details.

Experimental and calculated property data are now available. For more
information enter HELP PROP at an arrow prompt in the file or refer
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<http://www.cas.org/ONLINE/DBSS/registryss.html>

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L3 ANSWER 1 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
RN 7440-44-0 REGISTRY
CN Carbon (7CI, 8CI, 9CI) (CA INDEX NAME)
OTHER NAMES:
CN 1262R97
CN 207A
CN 207A (carbon)
CN 207E3
CN 20SPD
CN 2C98
CN 3GX
CN 4GCX
CN 4GM
CN 606R97
CN AC 01
CN AC 01 (adsorbent)
CN AC 100
CN AC 100 (adsorbent)
CN AC 40
CN AC 40 (adsorbent)
CN Acticarbon 25K
CN Acticarbon ENO
CN Acticarbon TK
CN Actitex CS 1501
CN Activated carbon
CN AG 2
CN AG 2 (catalyst support)
CN AG 2-4
CN AG 3
CN AG 3 (adsorbent)
CN AG 5
CN AG 5 (adsorbent)
CN AG 95
CN AG 95 (carbon)
CN AG-M
CN AG-M (carbon)
CN AG-OV 1

CN AGN 1
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 CN AGN 2
 CN AGN 2 (carbon)
 CN AGN 3
 CN AGS 3
 CN AGS 4
 CN AGS 4 (adsorbent)
 CN AK
 CN AK (adsorbent)
 CN Amoco PX 21
 CN Anthrasorb
 CN APB 10C
 CN AR 2
 CN AR 2 (carbon)
 CN AR 3
 CN AR 3 (carbon)

ADDITIONAL NAMES NOT AVAILABLE IN THIS FORMAT - Use FCN, FIDE, or ALL for
 DISPLAY

DR 12789-22-9, 130960-03-1, 67167-41-3, 114680-00-1, 37196-29-5, 137322-21-5,
 76416-61-0, 82600-58-6, 83138-28-7, 26837-67-2, 39422-04-3, 39434-34-9,
 116788-82-0, 208519-32-8, 208728-20-5

MF C
 CI COM
 LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, AQUIRE, BIOBUSINESS, BIOSIS,
 BIOTECHNO, CA, CABAB, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN,
 CHEMCATS, CHEMLIST, CIN, CSCHEM, CSNB, DDFU, DETHERM*, DIOGENES, DIPPR*,
 DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, HSDB*,
 IFICDB, IFIPAT, IFIUDB, IMSCOSEARCH, IPA, MEDLINE, MRCK*, MSDS-OHS,
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Other Sources: DSL**, EINECS**, TSCA**
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DT.CA CAplus document type: Book; Conference; Dissertation; Journal; Patent;
 Preprint; Report

RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study);
 CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role
 in record)

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 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)

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 (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses);
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 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)

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286676 REFERENCES IN FILE CA (1907 TO DATE)
 12778 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 287166 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 18 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 2 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN

RN 7440-22-4 REGISTRY

CN Silver (8CI, 9CI) (CA INDEX NAME)

OTHER NAMES:

CN 11000SP
 CN 1520D
 CN 15ED001
 CN 15ED173
 CN 3050HD
 CN 3200HD
 CN 6142D
 CN 7000C

CN 7000ID
 CN AA 0101
 CN Ag 1T
 CN Ag 3010
 CN Ag-C-GS
 CN AG-CO
 CN Ag-E 100
 CN Ag-E 350
 CN AgC 156I
 CN AgC 209
 CN AgC 2190
 CN AgC 239
 CN AgC 251
 CN AgC 401
 CN AgC-A
 CN AgC-D
 CN AGF 20S
 CN Algaedyn
 CN Argentum
 CN Astroflake 5
 CN AX 10C
 CN AY 6010
 CN AY 6080
 CN C 0083P
 CN C 200
 CN C 200 (metal)
 CN C.I. 77820
 CN Carey Lea silver
 CN Colloidal silver
 CN CW 7100
 CN D 25
 CN D 25 (metal)
 CN Degussa 67
 CN Degussa 80
 CN Dotite XA 208
 CN Du Pont 4943
 CN E 174
 CN E 20
 CN EA 0008
 CN EA 295
 CN ED 6036
 CN EG 20

ADDITIONAL NAMES NOT AVAILABLE IN THIS FORMAT - Use FCN, FIDE, or ALL for
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DR 12553-68-3, 87354-45-8, 87370-84-1

MF Ag

CI COM

LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, AQUIRE, BIOSIS, BIOTECHNO, CA, CABA, CANCERLIT, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS, CHEMINFORMRX, CHEMLIST, CHEMSAFE, CIN, CSCHEM, CSNB, DDFU, DETHERM*, DIOGENES, DIPPR*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA, MEDLINE, MRCK*, MSDS-OHS, NIOSHTIC, PIRA, PROMT, RTECS*, TOXCENTER, ULIDAT, USPAT2, USPATFULL, VETU, VTB
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Other Sources: DSL**, EINECS**, TSCA**

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DT.CA CAplus document type: Book; Conference; Dissertation; Journal; Patent; Preprint; Report

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RLD.P Roles for non-specific derivatives from patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

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reagent); USES (Uses)

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PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

157051 REFERENCES IN FILE CA (1907 TO DATE)
 5141 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 157290 REFERENCES IN FILE CAPLUS (1907 TO DATE)

L3 ANSWER 3 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 7440-18-8 REGISTRY
 CN Ruthenium (8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN Ru-A1
 CN Ruthenium black
 CN Ruthenium element
 DR 57572-01-7, 100041-48-3
 MF Ru
 CI COM
 LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, AQUIRE, BIOBUSINESS, BIOSIS,
 BIOTECHNO, CA, CABA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN,
 CHEMCATS, CHEMINFORMRX, CHEMLIST, CIN, CSCHEM, CSNB, DDFU, DETHERM*,
 DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, IFICDB,
 IFIPAT, IFIUDB, IPA, MEDLINE, MRCK*, MSDS-OHS, NIOSHTIC, PIRA, PROMT,
 TOXCENTER, TULSA, USPAT2, USPATFULL, VTB
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 DT.CA Caplus document type: Book; Conference; Dissertation; Journal; Patent;
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 RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study);
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 RLD.P Roles for non-specific derivatives from patents: ANST (Analytical
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 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)
 RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological
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 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)

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32446 REFERENCES IN FILE CA (1907 TO DATE)
 4459 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 32513 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 1 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 4 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 7440-16-6 REGISTRY
 CN Rhodium (8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN Rhodium black
 CN Rhodium-103
 DR 24546-24-5, 100041-37-0
 MF Rh
 CI COM
 LC STN Files: AGRICOLA, ANABSTR, BIOBUSINESS, BIOSIS, BIOTECHNO, CA, CABA,
 CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS, CHEMINFORMRX,
 CHEMLIST, CIN, CSCHEM, CSNB, DDFU, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2,
 ENCOMPPAT, ENCOMPPAT2, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA, MEDLINE,
 MRCK*, MSDS-OHS, NIOSHTIC, PDLCOM*, PIRA, PROMT, RTECS*, TOXCENTER,

TULSA, USPAT2, USPATFULL, VTB
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Other Sources: DSL**, EINECS**, TSCA**
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DT.CA Cplus document type: Book; Conference; Dissertation; Journal; Patent; Preprint; Report

RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

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35892 REFERENCES IN FILE CA (1907 TO DATE)
 3713 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 35940 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 1 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 5 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 7440-15-5 REGISTRY
 CN Rhenium (8CI, 9CI) (CA INDEX NAME)

OTHER NAMES:

CN NSC 600662
 CN Rhenium element
 MF Re
 CI COM

LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, BIOBUSINESS, BIOSIS, BIOTECHNO, CA, CANCERLIT, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS, CHEMINFORMRX, CHEMLIST, CIN, CSCHEM, DDFU, DETHERM*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, IFICDB, IFIPAT, IFIUDB, MEDLINE, MRCK*, MSDS-OHS, NIOSHTIC, PIRA, PROMT, RTECS*, TOXCENTER, TULSA, USPAT2, USPATFULL, VTB
 (*File contains numerically searchable property data)

Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)

DT.CA Cplus document type: Book; Conference; Dissertation; Journal; Patent; Preprint; Report

RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.P Roles for non-specific derivatives from patents: ANST (Analytical study); BIOL (Biological study); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

Re

PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

16707 REFERENCES IN FILE CA (1907 TO DATE)
 1411 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 16723 REFERENCES IN FILE CAPLUS (1907 TO DATE)

L3 ANSWER 6 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 7440-06-4 REGISTRY
 CN Platinum (8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN C.I. 77795
 CN Furuuchi 8105
 CN Liquid Bright Platinum
 CN Platinum black
 CN Platinum element
 CN PR 0
 CN TP 1
 CN TP 1 (metal)
 CN TPT 200
 CN TR 706
 DR 21547-63-7
 MF Pt
 CI COM
 LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, BIOBUSINESS, BIOSIS, BIOTECHNO, CA, CABA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS, CHEMINFORMRX, CHEMLIST, CHEMSAFE, CIN, CSCHEM, CSNB, DDFU, DETHERM*, DIOGENES, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA, MEDLINE, MRCK*, MSDS-OHS, NIOSHTIC, PIRA, PROMT, RTECS*, TOXCENTER, TULSA, ULIDAT, USPAT2, USPATFULL, VTB
 (*File contains numerically searchable property data)

Other Sources: DSL**, EINECS**, TSCA**

(**Enter CHEMLIST File for up-to-date regulatory information)

DT.CA Caplus document type: Book; Conference; Dissertation; Journal; Patent; Preprint; Report
 RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); CMPI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)
 RLD.P Roles for non-specific derivatives from patents: ANST (Analytical study); BIOL (Biological study); CMPI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)
 RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological study); CMPI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)
 RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical study); BIOL (Biological study); CMPI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

Pt

PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

125224 REFERENCES IN FILE CA (1907 TO DATE)
 6412 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 125419 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 1 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 7 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 7440-05-3 REGISTRY
 CN Palladium (8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN E 1010/W
 CN MPP 030
 CN MPP 050

CN MPP 080
 CN P 50
 CN P 50 (metal)
 CN Palladex 600
 CN Palladium black
 CN Palladium element
 CN SFP 1001P
 MF Pd
 CI COM
 LC STN Files: AGRICOLA, ANABSTR, BIOBUSINESS, BIOSIS, BIOTECHNO, CA,
 CANCERLIT, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS, CHEMINFORMRX,
 CHEMLIST, CIN, CSCHEM, CSNB, DDFU, DETHERM*, DRUGU, EMBASE, ENCOMPLIT,
 ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA,
 MEDLINE, MRCK*, MSDS-OHS, NIOSHTIC, PIRA, PROMT, RTECS*, TOXCENTER,
 TULSA, ULIDAT, USPAT2, USPATFULL, VTB
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)
 DT.CA Caplus document type: Book; Conference; Dissertation; Journal; Patent;
 Preprint; Report
 RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study);
 CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role
 in record)
 RLD.P Roles for non-specific derivatives from patents: ANST (Analytical
 study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)
 RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological
 study); CMBI (Combinatorial study); FORM (Formation, nonpreparative);
 MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC
 (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses);
 NORL (No role in record)
 RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical
 study); BIOL (Biological study); CMBI (Combinatorial study); FORM
 (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence);
 PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or
 reagent); USES (Uses)

Pd

PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

83942 REFERENCES IN FILE CA (1907 TO DATE)
 6090 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 84079 REFERENCES IN FILE CAPLUS (1907 TO DATE)

L3 ANSWER 8 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 1333-74-0 REGISTRY
 CN Hydrogen (8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN Dihydrogen
 CN Hydrogen (H2)
 CN Hydrogen molecule
 CN Mol. hydrogen
 CN Molecular hydrogen
 CN Orthohydrogen
 CN Parahydrogen
 CN Protium
 DR 725200-57-7
 MF H2
 CI COM
 LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, BIOBUSINESS, BIOSIS, BIOTECHNO,
 CA, CABA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS,
 CHEMINFORMRX, CHEMLIST, CHEMSAFE, CIN, CSCHEM, CSNB, DDFU, DETHERM*,
 DIOGENES, DIPPR*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT,
 ENCOMPPAT2, HSDB*, IFICDB, IFIPAT, IFIUDB, IMSCOSEARCH, IPA, MEDLINE,
 MRCK*, MSDS-OHS, NIOSHTIC, PDLCOM*, PIRA, PROMT, RTECS*, SPECINFO,
 TOXCENTER, TULSA, ULIDAT, USPAT2, USPATFULL
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)

DT.CA CAplus document type: Book; Conference; Dissertation; Journal; Patent; Preprint; Report
 RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)
 RLD.P Roles for non-specific derivatives from patents: ANST (Analytical study); BIOL (Biological study); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)
 RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)
 RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

H-H

291812 REFERENCES IN FILE CA (1907 TO DATE)
 3597 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 292175 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 1 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 9 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN

RN 110-63-4 REGISTRY
 CN 1,4-Butanediol (8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN 1,4-Butylene glycol
 CN 1,4-Dihydroxybutane
 CN 1,4-Tetramethylene glycol
 CN Butylene glycol
 CN Dabco DBO
 CN Diol 14B
 CN NSC 406696
 CN Polycure D
 CN Sucol B
 CN Tetramethylene 1,4-diol
 CN Tetramethylene glycol
 CN Vibracure A 250
 FS 3D CONCORD
 DR 732189-03-6
 MF C4 H10 O2
 CI COM
 LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, AQUIRE, BEILSTEIN*, BIOBUSINESS, BIOSIS, BIOTECHNO, CA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS, CHEMINFORMRX, CHEMLIST, CHEMSAFE, CIN, CSCHM, CSNB, DETHERM*, DIPPR*, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, GMELIN*, HODOC*, HSDB*, IFICDB, IFIUDB, IPA, MEDLINE, MSDS-OHS, NAPRALERT, NIOSHTIC, PDLCOM*, PIRA, PROMT, PS, RTECS*, SPECINFO, TOXCENTER, TULSA, ULIDAT, USPAT2, USPATFULL, VTB
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)
 DT.CA CAplus document type: Conference; Dissertation; Journal; Patent; Report
 RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)
 RLD.P Roles for non-specific derivatives from patents: ANST (Analytical study); BIOL (Biological study); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)
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(Formation, nonpreparative); MSC (Miscellaneous); PREP (Preparation);
 PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES
 (Uses)

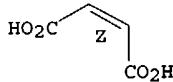
HO—(CH₂)₄—OH

PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

8334 REFERENCES IN FILE CA (1907 TO DATE)
 2352 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 8346 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 9 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 10 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 110-16-7 REGISTRY
 CN 2-Butenedioic acid (2Z)- (9CI) (CA INDEX NAME)
 OTHER CA INDEX NAMES:
 CN 2-Butenedioic acid (Z)-
 CN Maleic acid (8CI)
 OTHER NAMES:
 CN 2-Butenedioic acid, (Z)-
 CN cis-1,2-Ethylenedicarboxylic acid
 CN cis-2-Butenedioic acid
 CN cis-Butenedioic acid
 CN Maleinic acid
 CN Malezid CM
 CN Scotchbond Multipurpose Etchant
 CN Toxicilic acid
 FS STEREOSEARCH
 MF C4 H4 O4
 CI COM
 LC STN Files: AGRICOLA, ANABSTR, AQUIRE, BEILSTEIN*, BIOSIS,
 BIOTECHNO, CA, CABA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN,
 CHEMCATS, CHEMINFORMRX, CHEMLIST, CIN, CSCHEM, CSNB, DDFU, DETHERM*,
 DIPPR*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2,
 GMELIN*, HODOC*, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA, MEDLINE, MRCK*,
 MSDS-OHS, NAPRALERT, NIOSHTIC, PDLCOM*, PIRA, PROMT, PS, RTECS*,
 SPECINFO, SYNTHLINE, TOX CENTER, TULSA, USPAT2, USPATFULL
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)
 DT.CA CAplus document type: Book; Conference; Dissertation; Journal; Patent;
 Preprint; Report
 RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study);
 FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU
 (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT
 (Reactant or reagent); USES (Uses); NORL (No role in record)
 RLD.P Roles for non-specific derivatives from patents: ANST (Analytical
 study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)
 RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological
 study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU
 (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT
 (Reactant or reagent); USES (Uses); NORL (No role in record)
 RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical
 study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)

Double bond geometry as shown.

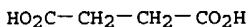


PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

13381 REFERENCES IN FILE CA (1907 TO DATE)
 3219 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA

13399 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 5 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 11 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 110-15-6 REGISTRY
 CN Butanedioic acid (9CI) (CA INDEX NAME)
 OTHER CA INDEX NAMES:
 CN Succinic acid (8CI)
 OTHER NAMES:
 CN 1,2-Ethanedicarboxylic acid
 CN 1,4-Butanedioic acid
 CN A 12084
 CN Amber acid
 CN Asuccin
 CN Dihydrofumaric acid
 CN Katasuccin
 CN NSC 106449
 CN NSC 25949
 CN Wormwood acid
 FS 3D CONCORD
 DR 623158-99-6
 MF C4 H6 O4
 CI COM
 LC STN Files: AGRICOLA, ANABSTR, AQUIRE, BEILSTEIN*, BIOBUSINESS, BIOSIS,
 BIOTECHNO, CA, CABA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN,
 CHEMCATS, CHEMINFORMX, CHEMLIST, CIN, CSCHEM, DDFU, DETHERM*, DIOGENES,
 DIPPR*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2,
 GMELIN*, HODOC*, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA, MEDLINE, MRCK*,
 MSDS-OHS, NAPRALERT, NIOSHTIC, PDLCOM*, PIRA, PROMT, RTECS*, SPECINFO,
 SYNTHLINE, TOXCENTER, TULSA, ULIDAT, USPAT2, USPATFULL, VETU, VTB
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)
 DT.CA CAplus document type: Book; Conference; Dissertation; Journal; Patent;
 Preprint; Report
 RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study);
 CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role
 in record)
 RLD.P Roles for non-specific derivatives from patents: ANST (Analytical
 study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)
 RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological
 study); CMBI (Combinatorial study); FORM (Formation, nonpreparative);
 MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC
 (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses);
 NORL (No role in record)
 RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical
 study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses)



PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

24646 REFERENCES IN FILE CA (1907 TO DATE)
 2612 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 24673 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 9 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 12 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 109-99-9 REGISTRY
 CN Furan, tetrahydro- (7CI, 8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN Butane .alpha..delta.-oxide
 CN Butane, 1,4-epoxy-
 CN Cyclotetramethylene oxide
 CN Furanidine
 CN NSC 57858
 CN Oxacyclopentane

CN Oxolane
 CN Tetrahydrofuran
 CN Tetramethylene oxide
 CN THF
 FS 3D CONCORD
 DR 77392-70-2
 MF C4 H8 O
 CI COM
 LC STN Files: ADISNEWS, AGRICOLA, ANABSTR, AQUIRE, BEILSTEIN*, BIOBUSINESS,
 BIOSIS, BIOTECHNO, CA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN,
 CHEMCATS, CHEMINFORMRX, CHEMLIST, CHEMSAFE, CIN, CSCHEM, CSNB, DDFU,
 DETERM*, DIPPR*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT,
 ENCOMPPAT2, GMELIN*, HODOC*, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA,
 MEDLINE, MRCK*, MSDS-OHS, NAPRALERT, NIOSHTIC, PDLCOM*, PIRA, PROMT,
 RTECS*, SPECINFO, SYNTHLINE, TOXCENTER, TULSA, ULIDAT, USPAT2,
 USPATFULL, VETU, VTB
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)

DT.CA Caplus document type: Book; Conference; Dissertation; Journal; Patent;
 Preprint; Report

RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study);
 CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process);
 PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role
 in record)

RLD.P Roles for non-specific derivatives from patents: ANST (Analytical
 study); BIOL (Biological study); FORM (Formation, nonpreparative); PREP
 (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or
 reagent); USES (Uses)

RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological
 study); CMBI (Combinatorial study); FORM (Formation, nonpreparative);
 MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC
 (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses);
 NORL (No role in record)

RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical
 study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC
 (Miscellaneous); PREP (Preparation); PROC (Process); PRP (Properties);
 RACT (Reactant or reagent); USES (Uses)



PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

21564 REFERENCES IN FILE CA (1907 TO DATE)
 800 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 21628 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 1 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 13 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 108-31-6 REGISTRY
 CN 2,5-Furandione (9CI) (CA INDEX NAME)
 OTHER CA INDEX NAMES:
 CN Maleic anhydride (8CI)
 OTHER NAMES:
 CN BM 10
 CN cis-Butenedioic anhydride
 CN Crystal Man
 CN Crystal Man AB
 CN Dihydro-2,5-dioxofuran
 CN HG 3-993-76
 CN Maleic acid anhydride
 CN Nourymix MA 901
 CN NSC 137651
 CN NSC 137652
 CN NSC 137653
 CN NSC 9568
 CN Toxilic anhydride
 FS 3D CONCORD
 DR 184288-31-1
 MF C4 H2 O3

CI COM
 LC STN Files: AGRICOLA, ANABSTR, AQUIRE, BEILSTEIN*, BIOBUSINESS, BIOSIS,
 BIOTECHNO, CA, CAOLD, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS,
 CHEMINFORMRX, CHEMLIST, CHEMSAFE, CIN, CSCHEM, CSNB, DDFU, DETHERM*,
 DIPPR*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2,
 GMELIN*, HODOC*, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA, MRCK*, MSDS-OHS,
 NIOSHTIC, PDLCOM*, PIRA, PROMT, PS, RTECS*, SPECINFO, SYNTHLINE,
 TOXCENTER, TULSA, USPAT2, USPATFULL, VTB
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)

DT.CA Caplus document type: Book; Conference; Dissertation; Journal; Patent; Report

RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.P Roles for non-specific derivatives from patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)



PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

31833 REFERENCES IN FILE CA (1907 TO DATE)
 14409 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 31895 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 13 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

L3 ANSWER 14 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 108-30-5 REGISTRY
 CN 2,5-Furandione, dihydro- (9CI) (CA INDEX NAME)
 OTHER CA INDEX NAMES:
 CN Succinic anhydride (8CI)
 OTHER NAMES:
 CN 2,5-Diketotetrahydrofuran
 CN Butanedioic anhydride
 CN Dihydro-2,5-furandione
 CN NSC 8518
 CN Rikacid SA
 CN Succinic acid anhydride
 CN Succinyl anhydride
 CN Succinyl oxide
 CN Tetrahydro-2,5-dioxofuran
 CN Tetrahydro-2,5-furandione
 FS 3D CONCORD
 MF C4 H4 O3
 CI COM
 LC STN Files: AGRICOLA, ANABSTR, AQUIRE, BEILSTEIN*, BIOBUSINESS, BIOSIS,
 BIOTECHNO, CA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS,
 CHEMINFORMRX, CHEMLIST, CIN, CSCHEM, CSNB, DDFU, DETHERM*, DIPPR*,
 DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPPAT, ENCOMPPAT2, GMELIN*,
 HODOC*, HSDB*, IFICDB, IFIPAT, IFIUDB, MEDLINE, MRCK*, MSDS-OHS,
 NIOSHTIC, PIRA, PROMT, PS, RTECS*, SPECINFO, SYNTHLINE, TOXCENTER,
 TULSA, USPAT2, USPATFULL, VTB
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)

DT.CA Caplus document type: Conference; Dissertation; Journal; Patent; Report

RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.P Roles for non-specific derivatives from patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological study); CMBI (Combinatorial study); FORM (Formation, nonpreparative); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)



PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

9401 REFERENCES IN FILE CA (1907 TO DATE)
 2849 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 9419 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 59 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

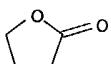
L3 ANSWER 15 OF 15 REGISTRY COPYRIGHT 2004 ACS on STN
 RN 96-48-0 REGISTRY]
 CN 2(3H)-Furanone, dihydro- (8CI, 9CI) (CA INDEX NAME)
 OTHER NAMES:
 CN .gamma.-BL
 CN .gamma.-Butalactone
 CN .gamma.-Butyrolactone
 CN .gamma.-Butyryllactone
 CN .gamma.-Hydroxybutyric acid lactone
 CN 1,4-Butanolide
 CN 1-Oxacyclopentan-2-one
 CN 2,3,4,5-Tetrahydro-2-furanone
 CN 2-Oxolanone
 CN 2-Oxotetrahydrofuran
 CN 4,5-Dihydro-2(3H)-furanone
 CN 4-Butanolide
 CN 4-Deoxytetroanic acid
 CN 4-Hydroxybutanoic acid lactone
 CN 4-Hydroxybutyric acid lactone
 CN Butanoic acid, 4-hydroxy-, .gamma.-lactone
 CN Butyric acid lactone
 CN Butyrolactone
 CN Dihydro-2(3H)-furanone
 CN NIH 10540
 CN NSC 4592
 CN Paint Clean G
 CN Tetrahydro-2-furanone
 FS 3D CONCORD
 DR 187997-16-6
 MF C4 H6 O2
 CI COM
 LC STN Files: ADISINSIGHT, ADISNEWS, AGRICOLA, ANABSTR, AQUIRE, BEILSTEIN*, BIOBUSINESS, BIOSIS, BIOTECHNO, CA, CANCERLIT, CAOLD, CAPLUS, CASREACT, CBNB, CEN, CHEMCATS, CHEMINFORMRX, CHEMLIST, CHEMSAFE, CIN, CSChem, CSNB, DDFU, DETHERM*, DIOGENES, DIPPR*, DRUGU, EMBASE, ENCOMPLIT, ENCOMPLIT2, ENCOMPAT, ENCOMPAT2, GMELIN*, HODOC*, HSDB*, IFICDB, IFIPAT, IFIUDB, IPA, MEDLINE, MRCK*, MSDS-OHS, NAPRALERT, NIOSHTIC, PDLCOM*, PIRA, PROMT, RTECS*, SPECINFO, SYNTHLINE, TOXCENTER, TULSA, ULIDAT, USPAT2, USPATFULL, VTB
 (*File contains numerically searchable property data)
 Other Sources: DSL**, EINECS**, TSCA**
 (**Enter CHEMLIST File for up-to-date regulatory information)
 DT.CA CAplus document type: Conference; Dissertation; Journal; Patent; Preprint; Report

RL.P Roles from patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.P Roles for non-specific derivatives from patents: BIOL (Biological study); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)

RL.NP Roles from non-patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses); NORL (No role in record)

RLD.NP Roles for non-specific derivatives from non-patents: ANST (Analytical study); BIOL (Biological study); FORM (Formation, nonpreparative); MSC (Miscellaneous); OCCU (Occurrence); PREP (Preparation); PROC (Process); PRP (Properties); RACT (Reactant or reagent); USES (Uses)



PROPERTY DATA AVAILABLE IN THE 'PROP' FORMAT

8341 REFERENCES IN FILE CA (1907 TO DATE)
 243 REFERENCES TO NON-SPECIFIC DERIVATIVES IN FILE CA
 8365 REFERENCES IN FILE CAPLUS (1907 TO DATE)
 37 REFERENCES IN FILE CAOLD (PRIOR TO 1967)

=> b wpix

[FILE 'WPIX'] ENTERED AT 11:21:57 ON 18 NOV 2004
 COPYRIGHT (C) 2004 THE THOMSON CORPORATION

FILE LAST UPDATED: 17 NOV 2004 <20041117/UP>
 MOST RECENT DERWENT UPDATE: 200474 <200474/DW>
 DERWENT WORLD PATENTS INDEX SUBSCRIBER FILE, COVERS 1963 TO DATE

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>>> FOR DETAILS OF THE PATENTS COVERED IN CURRENT UPDATES, SEE
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 GUIDES, PLEASE VISIT:
<http://thomsonderwent.com/support/userguides/> <<<

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 HIT STRUCTURES WITHIN THE BIBLIOGRAPHIC DOCUMENT <<<

>>> SMILES and ISOSMILES strings are no longer available as
 Derwent Chemistry Resource display fields <<<

=> d all 14 tot

L4 ANSWER 1 OF 1 WPIX COPYRIGHT 2004 THE THOMSON CORP on STN
 AN 2002-393725 [42] WPIX
 DNC C2002-110692
 TI Production of butyrolactone, 1,4-butanediol and/or tetrahydrofuran comprising catalytic hydrogenation of maleic acid to succinic acid and catalytic hydrogenation of succinic acid at low temperatures.
 DC A41 E13 E17
 IN ATTIG, T G; BUDGE, J R; HEPFER, R P; MILLER, C T; NORENBERG, G A
 PA (STAHL) STANDARD OIL CO OHIO; (ATTI-I) ATTIG T G; (BUDG-I) BUDGE J R;
 (HEPF-I) HEPFER R P; (MILL-I) MILLER C T; (NORE-I) NORENBERG G A

CYC 98
 PI WO 2002018316 A2 20020307 (200242)* EN 14 C07C051-36
 RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ
 NL OA PT SD SE SL SZ TR TZ UG ZW
 W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK
 DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR
 KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PH PL PT RO
 RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW
 AU 2001085320 A 20020313 (200249) C07C051-36
 EP 1313693 A2 20030528 (200336) EN C07C051-36
 R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT
 RO SE SI TR
 KR 2003027086 A 20030403 (200353) C07C029-149
 CN 1447786 A 20031008 (200403) C07C051-36
 US-2004039213 A1 20040226 (200416) C07D307-027 <--
 JP 2004507516 W 20040311 (200419) 28 C07C029-149
 ADT WO 2002018316 A2 WO 2001-US26765 20010827; AU 2001085320 A AU 2001-85320
 20010827; EP 1313693 A2 EP 2001-964473 20010827, WO 2001-US26765 20010827;
 KR 2003027086 A KR 2003-702790 20030226; CN 1447786 A CN 2001-814530
 20010827; US 2004039213 A1 Cont of US 2000-651526 20000829, US 2003-645429
 20030821; JP 2004507516 W WO 2001-US26765 20010827, JP 2002-523434
 20010827
 FDT AU 2001085320 A Based on WO 2002018316; EP 1313693 A2 Based on WO
 2002018316; JP 2004507516 W Based on WO 2002018316
 PRAI US 2000-651526 20000829; US 2003-645429 20030821
 IC ICM C07C029-149; C07C051-36; C07D307-02
 ICS C07C027-04; C07C031-20; C07C055-10; C07D307-33; C07D323-02
 AB WO 200218316 A UPAB: 20020704
 NOVELTY - Production of gamma -butyrolactone, 1,4-butanediol and/or
 tetrahydrofuran comprises reacting maleic acid with H₂ and catalyst in
 first hydrogenation zone (1HZ) to produce succinic acid; and reacting
 succinic acid with H₂ and catalyst in second hydrogenation zone.
 Temperature of maleic acid feedstream and 1HZ are controlled to below 130
 deg. C.
 DETAILED DESCRIPTION - Production of gamma -butyrolactone,
 1,4-butanediol and/or tetrahydrofuran (THF) comprises:
 (a) connecting a first hydrogenation zone (1HZ) and a second
 hydrogenation zone (2HZ) in series;
 (b) supplying a maleic acid feedstream to 1HZ;
 (c) reacting the maleic acid feedstock with H₂ in contact with a
 catalyst to produce succinic acid;
 (d) supplying the succinic acid to 2HZ;
 (e) reacting the succinic acid with H₂ in contact with a catalyst to
 produce a product stream.
 Temperature of maleic acid feedstream and 1HZ are controlled to below
 130 deg. C.
 USE - Product 1,4-butanediol is a commercial commodity with many
 uses, e.g. production of polybutylene terephthalate and reaction-injection
 molded (RIM) urethanes.
 ADVANTAGE - Temperature control minimizes the corrosive effects of
 maleic acid, prolongs reactor life and improves overall process economics.
 Dwg.0/0
 FS CPI
 FA AB; DCN
 MC CPI: A01-E14; E07-A01; E07-A02C; E10-E04C2; N02-E; N06-F; N07-B

=> b home
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(FILE 'HOME' ENTERED AT 11:06:28 ON 18 NOV 2004)
DEL HIS Y

FILE 'HCAPLUS' ENTERED AT 11:21:04 ON 18 NOV 2004
L1 1 US20040039213/PN

FILE 'REGISTRY' ENTERED AT 11:21:17 ON 18 NOV 2004

FILE 'HCAPLUS' ENTERED AT 11:21:23 ON 18 NOV 2004
L2 TRA L1 1- RN : 15 TERMS

FILE 'REGISTRY' ENTERED AT 11:21:23 ON 18 NOV 2004
L3 15 SEA L2

FILE 'WPIX' ENTERED AT 11:21:28 ON 18 NOV 2004
L4 1 US20040039213/PN

FILE 'REGISTRY' ENTERED AT 11:32:16 ON 18 NOV 2004
L5 1 110-16-7
L6 124 C4H4O4 AND MALEIC (1A) ACID NOT ((PMS OR MAN OR IDS)/CI OR UNSP
L7 1 96-48-0
L8 11 C4H6O2 AND BUTYROLACTONE NOT ((PMS OR MAN OR IDS)/CI OR UNSPECI
L9 5 L8 AND FURANONE
L10 6 L8 NOT L9
L11 1 109-99-9
L12 5 C4H8O AND THF NOT ((PMS OR MAN OR IDS)/CI OR UNSPECIFIED OR COM
L13 4 L12 NOT (MXS/CI OR MIXT)
L14 1 110-63-4
L15 1 L14 AND 1(1A)4 (1A) BUTANEDIOL NOT ((PMS OR MAN OR IDS)/CI OR U
L16 1 L14 AND (1 AND 4 AND BUTANEDIOL) NOT ((PMS OR MAN OR IDS)/CI OR
L17 1 110-15-6
L18 114 C4H6O4 AND SUCCINIC (1A) ACID NOT ((PMS OR MAN OR IDS)/CI OR UN

FILE 'HCAPLUS' ENTERED AT 11:47:12 ON 18 NOV 2004
E HYDROGENATION/CT
E E3+ALL
L19 48309 HYDROGENATION+NT/CT
E HYDROGEN CATALYST/CT
E HYDROGENATION CATALYST/CT
E E4+ALL
L20 38368 HYDROGENATION CATALYSTS+NT/CT
QUE L7 OR L9 OR FURANONE (2A) (DIHYDRO OR TETRAHYDRO) OR GAMMA
QUE OXOLANONE OR OXOTETRAHYDROFURAN OR DEOXYTETONIC (1A) ACID O
L23 129997 L11 OR L13 OR THF OR FURAN (1A) TETRAHYDRO OR BUTANE (2A) EPOXY
L24 30297 L14 OR L16 OR 1 (1A) 4 (1A) (BUTANEDIOL OR (TETRAMETHYLENE OR B
L25 43710 L5-6 OR (BUTENEDIOIC OR MALEI? OR ETHYLENEDICARBOXYLIC OR TOXIL
L26 47309 L17-18 OR (SUCCINIC OR ETHANEDICARBOXYLIC OR BUTANEDIOIC OR DIH
L27 318 L19 AND L25
E HEPFER R/AU
L28 2 E4-5
E MILLER C/AU
L29 160 E3, E50
E MILLER CRAIG/AU
L30 27 E3, E15-17
E NORENBERG G/AU
L31 1 E4
E ATTIG T/AU
L32 35 E4-6
E BUDGE J/AU
L33 40 E3, E5-7
L34 13774 (STANDARD (1A) OIL)/CS, PA
L35 5 L27 AND L28-34
L36 313 L27 NOT L35
L37 105 L36 AND L26
L38 37 L37 AND L21-24
L39 23 L38 AND L20
L40 QUE (PY<=2000 OR AY<=2000 OR PRY<=2000 OR PD<20000829 OR AD<200
L41 18 L39 AND L40
L42 4179 L25 (L) RACT+NT/RL
L43 5939 L26 (L) (PREP+NT OR RACT+NT) /RL
L44 14137 L21-24 (L) PREP+NT/RL
L45 134 L42 AND L19
L46 54 L45 AND L43
L47 24 L46 AND L44

L48 20 L47 AND L20
 L49 16 L48 AND L40
 L50 23 L41 OR L49

=> d all 135 tot)

L35 ANSWER 1 OF 5 HCAPLUS COPYRIGHT 2004 ACS on STN
 AN 2002:171834 HCAPLUS
 DN 136:217182
 ED Entered STN: 08 Mar 2002
 TI Two-stage process for the hydrogenation of maleic acid
 into 1,4-butanediol or THF or gamma-butyrolactone
 IN Hepfer, Robert P.; Miller, Craig T.; Attig,
 Thomas G.; Norenberg, Gregory A.; Budge, John R.
 PA The Standard Oil Company, USA
 SO PCT Int. Appl., 14 pp.
 CODEN: PIXXD2
 DT Patent
 LA English
 IC ICM C07C051-36
 ICS C07C055-10; C07C029-149; C07C031-20
 CC 35-2 (Chemistry of Synthetic High Polymers)
 Section cross-reference(s): 23, 27, 48

FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|------|-----------------|------|---|-----------------|----------|
| PI | WO 2002018316 | A2 | 20020307 | WO 2001-US26765 | 20010827 |
| | WO 2002018316 | A3 | 20020620 | | |
| | | W: | AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM | | |
| | | RW: | GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG | | |
| AU | 2001085320 | A5 | 20020313 | AU 2001-85320 | 20010827 |
| EP | 1313693 | A2 | 20030528 | EP 2001-964473 | 20010827 |
| | | R: | AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR | | |
| JP | 2004507516 | T2 | 20040311 | JP 2002-523434 | 20010827 |
| US | 2004039213 | A1 | 20040226 | US 2003-645429 | 20030821 |
| PRAI | US 2000-651526 | A | 20000829 | | |
| | WO 2001-US26765 | W | 20010827 | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|---------------|-------|---|
| WO 2002018316 | ICM | C07C051-36 |
| | ICS | C07C055-10; C07C029-149; C07C031-20 |
| JP 2004507516 | FTERM | 4C037/EA02; 4C037/EA03; 4H006/AA02; 4H006/AC11; 4H006/AC41; 4H006/AC46; 4H006/BA16; 4H006/BA23; 4H006/BA24; 4H006/BA25; 4H006/BA26; 4H006/BA55; 4H006/BC10; 4H006/BC11; 4H006/BD70; 4H006/BE20; 4H006/FE11; 4H039/CA19; 4H039/CA60; 4H039/CB10; 4H039/CB40 |

US 2004039213 ECLA C07C029/149

AB At least one of gamma-butyrolactone, 1,4-butanediol, and THF are prepared in a process comprising: (A) a first hydrogenation zone and a second hydrogenation zone connected in series; (B) supplying to the first hydrogenation zone a feedstream comprising maleic acid ; (C) reacting in the first hydrogenation zone, the maleic acid feedstock and hydrogen in contact with a catalyst to produce a reaction product comprising succinic acid; (D) supplying to the second hydrogenation zone, the reaction product of the first hydrogenationzone; (E) reacting in the second hydrogenation zone, the reaction product from the first hydrogenationzone and hydrogen in contact with a catalyst to produce a product stream comprising at least one of gamma-butyrolactone, 1,4-butanediol, and THF, where the temperature of the feedstream comprising maleic acid and the temperature of the first hydrogenation zone are controlled such that the temperature of maleic acid in the feedstream and the first hydrogenation zone does not exceed about 130.degree..

ST butanediol manuf two stage hydrogenation maleic acid; dihydroxybutane manuf two stage hydrogenation maleic acid; THF manuf two stage hydrogenation maleic

acid; butyrolactone manuf two stage hydrogenation maleic acid
IT Hydrogenation catalysts
(Pt-Group metals in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)
IT Platinum-group metals
RL: CAT (Catalyst use); USES (Uses)
(catalysts for the hydrogenation of maleic acid into 1,4-butanediol)
IT Hydrogenation
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)
IT 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-15-5, Rhenium, uses 7440-16-6, Rhodium, uses 7440-18-8, Ruthenium, uses 7440-22-4, Silver, uses
RL: CAT (Catalyst use); USES (Uses)
(catalysts in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)
IT 7440-44-0, Carbon, uses
RL: CAT (Catalyst use); USES (Uses)
(support; catalysts in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)
IT 110-16-7B, Maleic acid, preparation
RL: PNU (Preparation, unclassified); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)
IT 96-48-0P, .gamma.-Butyrolactone
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or)
IT 110-15-6P, Succinic acid, preparation
RL: PNU (Preparation, unclassified); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)
IT 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6D, Succinic acid, esters 110-16-7D, Maleic acid, esters 1333-74-0, Hydrogen, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)
IT 109-99-9P, Thf, preparation
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or gamma-butyrolactone or)
IT 110-63-4P, 1,4-Butanediol, preparation
RL: IMF (Industrial manufacture); PREP (Preparation)
(two-stage process for the hydrogenation of maleic acid into gamma-butyrolactone or THF or)

L35 ANSWER 2 OF 5 HCPLUS COPYRIGHT 2004 ACS on STN
AN 2001:128171 HCPLUS
DN 134:164831
ED Entered STN: 21 Feb 2001
TI Process for hydrogenation of maleic acid to 1,4-butanediol by using oxidized carbon-supported catalysts
IN Budge, John R.; Attig, Thomas G.; Dubbert, Robert A.
PA The Standard Oil Company, USA
SO Jpn. Kokai Tokkyo Koho, 30 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM B01J023-66
ICS B01J023-89; C07B061-00; C07C029-149; C07C031-20; C07D307-08
CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)
Section cross-reference(s): 23, 67

FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|------|----------------|------|----------|-----------------|----------|
| PI | JP 2001046871 | A2 | 20010220 | JP 1999-219971 | 19990803 |
| | AU 772779 | B2 | 20040506 | AU 1999-43498 | 19990809 |
| | AU 9943498 | A1 | 20010215 | | |
| PRAI | JP 1999-219971 | A | 19990803 | | |

CLASS

PATENT NO. CLASS PATENT FAMILY CLASSIFICATION CODES

JP 2001046871 ICM B01J023-66
 ICS B01J023-89; C07B061-00; C07C029-149; C07C031-20;
 C07D307-08

AB Maleic acid, maleic anhydride and other hydrogenatable precursors are catalytically hydrogenated into 1,4-butanediol and THF by using a hydrogenation catalyst comprising palladium, silver, rhenium, and .gtoreq.1 aluminum, and/or cobalt on a carbon support, wherein the catalyst is prepared by (i) oxidizing the carbon support with an oxidizing agent; (ii) impregnating the treated support in .gtoreq.1 impregnation step comprising contacting the support with a source of palladium, silver, rhenium, and .gtoreq.1 aluminum, and/or cobalt, resp.; (iii) drying the impregnated support to remove solvent after each impregnation; and (iv) heating the dried support. The use of the catalyst in the process give a higher yield of i,4-butanediol with minimal formation of .gamma.-butyrolactone byproduct.

ST butanediol THF prepn maleic anhydride hydrogenation; carbon support oxidized hydrogenation catalyst; palladium silver rhenium carbon supported catalyst; aluminum cobalt carbon supported catalyst

IT Catalyst supports

Hydrogenation

Hydrogenation catalysts

(process for hydrogenation of anhydrides or dicarboxylic acids to diol by using palladium, silver and rhenium on oxidized carbon supports)

IT 7440-44-0, Norit RX 1.5 Extra, uses

RL: CAT (Catalyst use); USES (Uses)
 (activated, support; process for hydrogenation of anhydrides or dicarboxylic acids to diol by using palladium, silver and rhenium on oxidized carbon supports)

IT 7429-90-5, Aluminum, uses 7440-48-4, Cobalt, uses 7761-88-8, Silver nitrate, uses 7782-61-8, Ferric nitrate nonahydrate 10102-05-3, Palladium nitrate 13768-11-1, Perrhenic acid

RL: CAT (Catalyst use); USES (Uses)
 (process for hydrogenation of anhydrides or dicarboxylic acids to diol by using palladium, silver and rhenium on oxidized carbon supports)

IT 109-99-9P, THF, preparation 110-63-4P, 1,4-Butanediol, preparation

RL: IMF (Industrial manufacture); PREP (Preparation)
 (process for hydrogenation of anhydrides or dicarboxylic acids to diol by using palladium, silver and rhenium on oxidized carbon supports)

IT 96-48-0, .gamma.-Butyrolactone 106-65-0, Dimethyl succinate 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions 110-15-6D, Succinic acid, esters

110-16-7, Maleic acid, reactions

110-16-7D, Maleic acid, esters

110-17-8, Fumaric acid, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
 (process for hydrogenation of anhydrides or dicarboxylic acids to diol by using palladium, silver and rhenium on oxidized carbon supports)

L35 ANSWER 3 OF 5 HCPLUS COPYRIGHT 2004 ACS on STN

AN 1999:670143 HCPLUS

DN 131:272328

ED Entered STN: 21 Oct 1999

TI Process and catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol

IN Budge, John Raymond; Attig, Thomas George; Dubbert, Robert Allen

PA The Standard Oil Company, USA

SO U.S., 7 pp., Cont.-in-part of U.S. Ser. No. 781,945, abandoned.

CODEN: USXXAM

DT Patent

LA English

IC ICM C07D307-02

NCL 549508000

CC 35-2 (Chemistry of Synthetic High Polymers)

Section cross-reference(s): 23, 67

FAN.CNT 2

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|----|------------|------|----------|-----------------|----------|
| PI | US 5969164 | A | 19991019 | US 1998-56193 | 19980406 |
| | SG 74602 | A1 | 20000822 | SG 1997-3830 | 19971022 |
| | AU 9743631 | A1 | 19980625 | AU 1997-43631 | 19971029 |
| | AU 720496 | B2 | 20000601 | | |
| | AT 262376 | E | 20040415 | AT 1997-310014 | 19971211 |

| | | | | |
|--|----|----------|------------------|----------|
| JP 10192709 | A2 | 19980728 | JP 1997-347597 | 19971217 |
| CN 1185993 | A | 19980701 | CN 1997-108787 | 19971219 |
| CN 1094791 | B | 20021127 | | |
| TW 415938 | B | 20001221 | TW 1997-86119385 | 19971219 |
| EP 1077080 | A1 | 20010221 | EP 1999-306525 | 19990818 |
| R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO | | | | |
| SG 84543 | A1 | 20011120 | SG 1999-4399 | 19990908 |
| PRAI US 1996-781945 | B2 | 19961220 | | |

CLASS

PATENT NO. CLASS PATENT FAMILY CLASSIFICATION CODES

| | | |
|------------|-----|------------|
| US 5969164 | ICM | C07D307-02 |
| | NCL | 549508000 |

AB A catalyst for the hydrogenation of maleic acid, maleic anhydride, or other hydrogenatable precursors (e.g., di-Me succinate) to 1,4-butanediol in high yield and selectivity is described which comprises palladium, silver, rhenium, and at least one of iron, aluminum, cobalt, or their mixts. all on a carbon support. The hydrogenation catalyst is prepared by first oxidizing the carbon support by contacting it with an oxidizing agent (e.g., nitric acid), followed by impregnating the oxidized support with a source of the catalytic metals, drying the impregnated support, and heating the dried support at 100-350.degree. under reducing conditions.

ST butanediol manuf maleic acid hydrogenation;
hydrogenation catalyst maleic anhydride prepn butanediol

IT Oxidation

(of a carbon support in the preparation of a hydrogenation catalyst for the conversion of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT Hydrogenation

(of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT Reduction

(of metal-impregnated and dried carbon support in the preparation of catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT Hydrogenation catalysts

(palladium and silver and rhenium and at least one of iron and/or aluminum and/or cobalt and/or their mixts. all on a carbon support for the conversion of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 7429-90-5, Aluminum, uses 7439-89-6, Iron, uses 7440-05-3, Palladium, uses 7440-15-5, Rhenium, uses 7440-22-4, Silver, uses 7440-48-4, Cobalt, uses

RL: CAT (Catalyst use); USES (Uses)
(catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 7601-90-3, Perchloric acid, reactions 7681-52-9, Sodium hypochlorite 7697-37-2, Nitric acid, reactions 7722-84-1, Hydrogen peroxide, reactions 7727-54-0, Ammonium persulfate

RL: RCT (Reactant); RACT (Reactant or reagent)
(in the preparation of catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 109-99-9P, Thf, preparation 110-63-4P, 1,4-Butanediol, preparation

RL: IMF (Industrial manufacture); PREP (Preparation)
(process and catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 96-48-0, .gamma.-Butyrolactone 106-65-0, Dimethyl succinate 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions 110-15-6D, Succinic acid, esters

110-16-7, Maleic acid, reactions

110-16-7D, Maleic acid, esters

110-17-8, Fumaric acid, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(process and catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 7440-44-0, Carbon, reactions

RL: CAT (Catalyst use); RCT (Reactant); RACT (Reactant or reagent); USES (Uses)

(support; catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

RE.CNT 1 THERE ARE 1 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

(1) Kitson; US 4985572 1991 HCPLUS

L35 ANSWER 4 OF 5 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1999:355604 HCPLUS
 DN 130:352770
 ED Entered STN: 10 Jun 1999
 TI Process and catalysts for the hydrogenation of maleic acid or its derivatives into 1,4-butanediol
 IN Attig, Thomas George; Budge, John Raymond; Dubbert, Robert Allen
 PA The Standard Oil Company, USA
 SO Eur. Pat. Appl., 8 pp.
 CODEN: EPXXDW
 DT Patent
 LA English
 IC ICM C07C029-17
 ICS C07C029-149
 CC 35-2 (Chemistry of Synthetic High Polymers)
 Section cross-reference(s): 23, 48, 67
 FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|------|---|------|----------|------------------|----------|
| PI | EP 919530 | A1 | 19990602 | EP 1998-309711 | 19981126 |
| | EP 919530 | B1 | 20020213 | | |
| | R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO | | | | |
| | US 6486367 | B1 | 20021126 | US 1997-980542 | 19971201 |
| | AU 9891414 | A1 | 19990617 | AU 1998-91414 | 19981109 |
| | AU 756102 | B2 | 20030102 | | |
| | SG 74671 | A1 | 20000822 | SG 1998-4651 | 19981111 |
| | ES 2172865 | T3 | 20021001 | ES 1998-309711 | 19981126 |
| | CN 1229072 | A | 19990922 | CN 1998-125255 | 19981130 |
| | CN 1110472 | B | 20030604 | | |
| | MX 9810028 | A | 20000131 | MX 1998-10028 | 19981130 |
| | JP 11240846 | A2 | 19990907 | JP 1998-342228 | 19981201 |
| | TW 401317 | B | 20000811 | TW 1998-87119806 | 19990224 |
| | ZA 9904944 | A | 20000207 | ZA 1999-4944 | 19990802 |
| PRAI | US 1997-980542 | A | 19971201 | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
| EP 919530 | ICM | C07C029-17 |
| | ICS | C07C029-149 |
| EP 919530 | ECLA | C07C029/17F |
| US 6486367 | ECLA | C07C029/17F |

AB 1,4-Butanediol is prepared in high yield and selectivity by the hydrogenation of maleic acid and/or its hydrogenatable precursors (e.g., gamma-butyrolactone, fumaric acid, succinic acid, etc.) in the presence of a platinum-group metal catalyst (e.g., Pd and Re); the production and yield of 1,4-butanediol is enhanced by the addition of 20-160 ppm of iron, in the form of an iron compound (e.g., iron acetate), to the hydrogenatable precursor feed.

ST butanediol manuf maleic acid hydrogenation;
 hydrogenation catalyst iron additive manuf butanediol

IT Platinum-group metals
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts with iron compds. for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT Hydrogenation
 (of maleic acid or its derivs. into 1,4-butanediol)

IT Hydrogenation catalysts
 (platinum-group metals with iron compds. for the conversion of maleic acid or its derivs. into 1,4-butanediol)

IT 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-16-6, Rhodium, uses 7440-18-8, Ruthenium, uses
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts with iron compds. for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 7440-15-5, Rhenium, uses 7440-22-4, Silver, uses
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts with platinum-group metals and iron compds. for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 2140-52-5, Iron acetate 7439-89-6, Iron, uses 14451-00-4, Iron fumarate 31516-56-0, Maleic acid iron salt 38781-07-6, Butanoic acid, iron salt 43212-87-9, Iron succinate 72535-95-6, Iron propionate
 RL: CAT (Catalyst use); USES (Uses)

(catalysts with platinum-group metals for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 110-63-4P, 1,4-Butanediol, preparation
 RL: IMF (Industrial manufacture); PREP (Preparation)
 (process and catalysts for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 96-48-0, .gamma.-Butyrolactone 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions 110-15-6D, Succinic acid, di(C1-8 alkyl) esters 110-16-7, Maleic acid, reactions 110-16-7D, Maleic acid, di(C1-8 alkyl) esters 110-17-8, Fumaric acid, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (process and catalysts for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 7440-44-0, Carbon, uses
 RL: CAT (Catalyst use); USES (Uses)
 (support; catalysts with platinum-group metals and iron compds. for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

RE.CNT 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

- (1) Attig, T; US 4827001 A 1989 HCPLUS
- (2) Hoechst; GB 1551741 A 1979 HCPLUS
- (3) Kitson, M; US 5149680 A 1992 HCPLUS

L35 ANSWER 5 OF 5 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1998:1355 HCPLUS
 DN 128:63169
 ED Entered STN: 02 Jan 1998
 TI Catalysts for the hydrogenation of aqueous solutions of maleic acid and its derivatives into 1,4-butanediol
 IN Pedersen, S. Erik; Frye, John G., Jr.; Attig, Thomas G.;
 Budge, John R.
 PA Standard Oil Co., USA
 SO U.S., 7 pp.
 CODEN: USXXAM
 DT Patent
 LA English
 IC ICM C07C029-149
 ICS C07D307-08
 NCL 568864000
 CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)
 Section cross-reference(s): 23, 48, 67

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---|------|----------|------------------|----------|
| US 5698749 | A | 19971216 | US 1995-524195 | 19950906 |
| EP 881203 | A1 | 19981202 | EP 1997-303664 | 19970530 |
| EP 881203 | B1 | 20010919 | | |
| R: AT, BE, DE, ES, FR, GB, IT, NL AT 205820 ES 2164992 TW 419456 | E | 20011015 | AT 1997-303664 | 19970530 |
| | T3 | 20020301 | ES 1997-303664 | 19970530 |
| | B | 20010121 | TW 1997-86114367 | 19971002 |
| PRAI US 1995-524195 | A | 19950906 | | |
| EP 1997-303664 | A | 19970530 | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|--|------------------------------------|
| US 5698749 | ICM C07C029-149 ICS C07D307-08 NCL 568864000 | |

AB Maleic acid, maleic anhydride and its other hydrogenatable derivs. (e.g., fumaric acid, succinic acid, etc.) are catalytically hydrogenated into 1,4-butanediol with reduced formation of THF and .gamma.-butyrolactone when the hydrogenation catalyst comprises .gtoreq.1 noble metal of Group VIII and .gtoreq.1 of Re, W, or Mo on a carbon support, which support has been contacted with an oxidizing agent prior to deposition of the metals. These catalysts are prepared by: (i) oxidizing the carbon support by contacting it with an oxidizing agent (e.g., HNO₃, H₂O₂, HClO₄, etc.); (ii) impregnating the treated support in .gtoreq.1 impregnation step(s); (iii) drying; and (iv.) heating the dried, impregnated support under reducing conditions.

ST butanol prepn maleic anhydride hydrogenation; catalyst hydrogenation prepn

IT Hydrogenation catalysts

(Group VIII elements and Re and/or W and/or Mo on an oxidant-treated

carbon support for the conversion of aqueous solns. of maleic acid and its derivs. to 1,4-butanediol)

IT Group VIII elements
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. to 1,4-butanediol)

IT Hydrogenation
 (of aqueous solns. of maleic acid and its derivs. to 1,4-butanediol)

IT 7439-98-7, Molybdenum, uses 7440-15-5, Rhenium, uses 7440-33-7, Tungsten, uses 7440-44-0, Carbon, uses
 RL: CAT (Catalyst use); USES (Uses)
 (process and catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. into 1,4-butanediol)

IT 110-63-4P, 1,4-Butanediol, preparation
 RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)
 (process and catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. into 1,4-butanediol)

IT 96-48-0, .gamma.-Butyrolactone 106-65-0, Dimethyl succinate 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions 110-16-7, Maleic acid, reactions 110-17-8, Fumaric acid, reactions 7601-90-3, Perchloric acid, reactions 7681-52-9, Sodium hypochlorite 7697-37-2, Nitric acid, reactions 7722-84-1, Hydrogen peroxide, reactions 7727-54-0, Ammonium persulfate
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (process and catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. into 1,4-butanediol)

=> d all 150 tot

L50 ANSWER 1 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 2002:171834 HCPLUS
 DN 136:217182
 ED Entered STN: 08 Mar 2002
 TI Two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone
 IN Hepfer, Robert P.; Miller, Craig T.; Attig, Thomas G.; Norenberg, Gregory A.; Budge, John R.
 PA The Standard Oil Company, USA
 SO PCT Int. Appl., 14 pp.
 CODEN: PIXXD2
 DT Patent
 LA English
 IC ICM C07C051-36
 ICS C07C055-10; C07C029-149; C07C031-20
 CC 35-2 (Chemistry of Synthetic High Polymers)
 Section cross-reference(s): 23, 27, 48
 FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---------|---|------|--------------|-----------------|--------------|
| PI | WO 2002018316 | A2 | 20020307 | WO 2001-US26765 | 20010827 <-- |
| | WO 2002018316 | A3 | 20020620 | | |
| | W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM | | | | |
| | RW: GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG | | | | |
| AU | 2001085320 | A5 | 20020313 | AU 2001-85320 | 20010827 <-- |
| EP | 1313693 | A2 | 20030528 | EP 2001-964473 | 20010827 <-- |
| | R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR | | | | |
| JP | 2004507516 | T2 | 20040311 | JP 2002-523434 | 20010827 <-- |
| US | 2004039213 | A1 | 20040226 | US 2003-645429 | 20030821 <-- |
| PRAI US | 2000-651526 | A | 20000829 <-- | | |
| | WO 2001-US26765 | W | 20010827 | | |

CLASS
 PATENT NO. CLASS PATENT FAMILY CLASSIFICATION CODES
 WO 2002018316 ICM C07C051-36

ICS C07C055-10; C07C029-149; C07C031-20
 JP 2004507516 FTERM 4C037/EA02; 4C037/EA03; 4H006/AA02; 4H006/AC11;
 4H006/AC41; 4H006/AC46; 4H006/BA16; 4H006/BA23;
 4H006/BA24; 4H006/BA25; 4H006/BA26; 4H006/BA55;
 4H006/BC10; 4H006/BC11; 4H006/BD70; 4H006/BE20;
 4H006/FE11; 4H039/CA19; 4H039/CA60; 4H039/CB10;
 4H039/CB40

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US 2004039213 ECLA C07C029/149

AB At least one of gamma-butyrolactone, 1,4-butanediol, and THF are prepared in a process comprising: (A) a first hydrogenation zone and a second hydrogenation zone connected in series; (B) supplying to the first hydrogenation zone a feedstream comprising maleic acid; (C) reacting in the first hydrogenation zone, the maleic acid feedstock and hydrogen in contact with a catalyst to produce a reaction product comprising succinic acid; (D) supplying to the second hydrogenation zone, the reaction product of the first hydrogenation zone; (E) reacting in the second hydrogenation zone, the reaction product from the first hydrogenation zone and hydrogen in contact with a catalyst to produce a product stream comprising at least one of gamma-butyrolactone, 1,4-butanediol, and THF, where the temperature of the feedstream comprising maleic acid and the temperature of the first hydrogenation zone are controlled such that the temperature of maleic acid in the feedstream and the first hydrogenation zone does not exceed about 130.degree..

ST butanediol manuf two stage hydrogenation maleic acid; dihydroxybutane manuf two stage hydrogenation maleic acid; THF manuf two stage hydrogenation maleic acid

IT **Hydrogenation catalysts**

(Pt-Group metals in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT **Platinum-group metals**

RL: CAT (Catalyst use); USES (Uses)
 (catalysts for the hydrogenation of maleic acid into 1,4-butanediol)

IT **Hydrogenation**

(two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-15-5, Rhenium, uses 7440-16-6, Rhodium, uses 7440-18-8, Ruthenium, uses 7440-22-4, Silver, uses
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT 7440-44-0, Carbon, uses

RL: CAT (Catalyst use); USES (Uses)
 (support; catalysts in a two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT 110-16-7P, Maleic acid, preparation

RL: PNU (Preparation, unclassified); RCT (Reactant);
 PREP (Preparation); RACT (Reactant or reagent)
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol)

IT 96-48-0P, .gamma.-Butyrolactone

RL: IMF (Industrial manufacture); RCT (Reactant);
 PREP (Preparation); RACT (Reactant or reagent)
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or)

IT 110-15-6P, Succinic acid, preparation

RL: PNU (Preparation, unclassified); RCT (Reactant);
 PREP (Preparation); RACT (Reactant or reagent)
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)

IT 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride,

reactions 110-15-6D, Succinic acid, esters

110-16-7D, Maleic acid, esters 1333-74-0,

Hydrogen, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)

IT 109-99-9P, Thf, preparation

RL: IMF (Industrial manufacture); RCT (Reactant);
 PREP (Preparation); RACT (Reactant or reagent)
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or gamma-butyrolactone or)

IT 110-63-4P, 1,4-Butanediol,
preparation
RL: IMF (Industrial manufacture); PREP (Preparation)
(two-stage process for the hydrogenation of maleic acid into
gamma-butyrolactone or THF or)

L50 ANSWER 2 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
AN 2001:713278 HCAPLUS
DN 135:242663
ED Entered STN: 28 Sep 2001
TI Hydrogenative method for the production of alcohols from carbonyl
compounds using rhenium-containing, activated carbon-supported catalysts
IN Fischer, Rolf-Hartmuth; Pinkos, Rolf; Schunk, Stephan Andreas;
Wulff-Doering, Joachim
PA Basf Aktiengesellschaft, Germany
SO PCT Int. Appl., 11 pp.
CODEN: PIXXD2
DT Patent
LA German
IC ICM C07C029-00
CC 35-2 (Chemistry of Synthetic High Polymers)
Section cross-reference(s): 21, 67

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|--|------|--------------|------------------|--------------|
| WO 2001070657 | A2 | 20010927 | WO 2001-EP3374 | 20010323 <-- |
| WO 2001070657 | A3 | 20011220 | | |
| W: CN, JP, KR, US | | | | |
| RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR | | | | |
| DE 10014646 | A1 | 20010927 | DE 2000-10014646 | 20000324 <-- |
| EP 1272270 | A2 | 20030108 | EP 2001-936136 | 20010323 <-- |
| R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, FI, CY, TR | | | | |
| JP 2003528064 | T2 | 20030924 | JP 2001-568870 | 20010323 <-- |
| US 2003050516 | A1 | 20030313 | US 2002-239409 | 20020923 |
| US 6765118 | B2 | 20040720 | | |
| PRAI DE 2000-10014646 | A | 20000324 <-- | | |
| WO 2001-EP3374 | W | 20010323 | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|---------------|-------|---------------------------------------|
| WO 2001070657 | ICM | C07C029-00 |
| DE 10014646 | ECLA | B01J023/36; B01J023/889H; C07C029/149 |

AB Alcs. (e.g., 1,4-butanediol) are prepared in
high yield and selectivity by the catalytic hydrogenation of carbonyl
compds. (e.g., maleic acid) using a catalyst containing
0.01-50% rhenium and 0-20% (based upon total catalyst weight) of Zn, Cu, Ag,
Au, Ni, Fe, Cr, or V supported on oxidatively (e.g., HNO₃) pretreated
activated carbon.

ST butanediol prepn maleic acid hydrogenation; alc manuf
carbonyl compd hydrogenation; catalyst hydrogenation carbonyl compd manuf
alc

IT Hydrogenation catalysts

(Re/C for the conversion of carbonyl compds. into alcs.)

IT Carboxylic acids, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(dicarboxylic; hydrogenative method for the production of alcs. from
carbonyl compds. using rhenium-containing, activated carbon-supported
catalysts)

IT Carboxylic acids, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(esters; hydrogenative method for the production of alcs. from carbonyl
compds. using rhenium-containing, activated carbon-supported catalysts)

IT Alcohols, preparation

Glycols, preparation

RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP
(Preparation)

(hydrogenative method for the production of alcs. from carbonyl compds.
using rhenium-containing, activated carbon-supported catalysts)

IT Aldehydes, reactions

Anhydrides

Carbonyl compounds (organic), reactions

Carboxylic acids, reactions

Lactones

RL: RCT (Reactant); RACT (Reactant or reagent)

(hydrogenative method for the production of alcs. from carbonyl compds. using rhenium-containing, activated carbon-supported catalysts)

IT **Hydrogenation**
(of carbonyl compds. into alcs.)

IT 7440-44-0, Activated carbon, uses
RL: CAT (Catalyst use); USES (Uses)
(activated, support; hydrogenative method for the production of alcs. from carbonyl compds. using rhenium-containing, activated carbon-supported catalysts)

IT 7439-89-6, Iron, uses 7440-02-0, Nickel, uses 7440-15-5, Rhenium, uses 7440-22-4, Silver, uses 7440-47-3, Chromium, uses 7440-50-8, Copper, uses 7440-57-5, Gold, uses 7440-62-2, Vanadium, uses 7440-66-6, Zinc, uses
RL: CAT (Catalyst use); USES (Uses)
(hydrogenative method for the production of alcs. from carbonyl compds. using rhenium-containing, activated carbon-supported catalysts)

IT 110-63-4P, 1,4-Butanediol,
preparation 629-11-8P, 1,6-Hexanediol 118562-73-5P
RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)
(hydrogenative method for the production of alcs. from carbonyl compds. using rhenium-containing, activated carbon-supported catalysts)

IT 96-48-0, .gamma.-Butyrolactone 108-31-6,
Maleic anhydride, reactions 110-15-6, Succinic acid, reactions 110-16-7, Maleic acid , reactions 110-17-8, Fumaric acid, reactions 502-44-3, Caprolactone 1191-25-9, 6=Hydroxycaproic acid 178804-38-1
RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenative method for the production of alcs. from carbonyl compds. using rhenium-containing, activated carbon-supported catalysts)

L50 ANSWER 3 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
AN 2001:657477 HCAPLUS
DN 135:211419
ED Entered STN: 07 Sep 2001
TI Procedure for the production of alcohols by the hydrogenation of carbonyl compounds using rhenium-and-platinum-containing catalyst with an activated carbon support
IN Fischer, Rolf Hartmuth; Pinkos, Rolf; Schunk, Stephan Andreas; Wulff-Doering, Joachim; Stein, Frank
PA BASF A.-G., Germany
SO Ger. Offen., 6 pp.
CODEN: GWXXBX
DT Patent
LA German
IC ICM C07C029-136
ICS B01J023-656
CC 35-2 (Chemistry of Synthetic High Polymers)
Section cross-reference(s): 23, 45, 67

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---|------|--------------|------------------|--------------|
| PI DE 10009817 | A1 | 20010906 | DE 2000-10009817 | 20000301 <-- |
| WO 2001064338 | A1 | 20010907 | WO 2001-EP2337 | 20010301 <-- |
| W: JP, KR, US RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR | | | | |
| EP 1261423 | A1 | 20021204 | EP 2001-909811 | 20010301 <-- |
| R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, FI, CY, TR | | | | |
| US 2003114719 | A1 | 20030619 | US 2002-220566 | 20021029 <-- |
| PRAI DE 2000-10009817 | A | 20000301 <-- | | |
| WO 2001-EP2337 | W | 20010301 | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|---|--|------------------------------------|
| DE 10009817 | ICM C07C029-136 ICS B01J023-656 | |
| DE 10009817 | ECLA B01J021/18; B01J023/656H; B01J023/89G16; C07C029/17F<-- | |
| US 2003114719 | ECLA B01J021/18; B01J023/656H; B01J023/89G16; C07C029/17F<-- | |
| AB Alcs. (e.g., 1,4-butanediol) are prepared by catalytic hydrogenation of carbonyl compds. (e.g., maleic acid) using a rhenium-platinum-containing catalyst with an activated carbon support which contains 0.0001-0.5% rhenium (in a weight ratio to the activated carbon), 0.0001-0.5% platinum, and, optionally, 0-0.25% of at least one of Zn, Cu, Ag, Au, Ni, Fe, Ru, Mn, Cr, Mo, W, and V, where the | | |

activated carbon is nonoxidatively pretreated with a nonoxidative acid (e.g., sulfuric acid) or base.

ST alc manuf carbonyl compd hydrogenation; hydrogenation catalyst alc manuf; butanediol manuf **maleic acid** hydrogenation

IT Carboxylic acids, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(esters; production of alcs. by the hydrogenation of)

IT Acids, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(inorg., nonoxidative; procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support pretreated with)

IT Bases, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(nonoxidative; procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support pretreated with)

IT Acids, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(organic, nonoxidative; procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support pretreated with)

IT **Hydrogenation catalysts**
(procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

IT Aldehydes, reactions
Anhydrides
Carboxylic acids, reactions
Lactones
RL: RCT (Reactant); RACT (Reactant or reagent)
(production of alcs. by the hydrogenation of)

IT **Hydrogenation**
(production of alcs. by the hydrogenation of carbonyl compds.)

IT Glycols, preparation
RL: IMF (Industrial manufacture); PREP (Preparation)
(production of alcs. by the hydrogenation of carbonyl compds.)

IT Alcohols, preparation
RL: IMF (Industrial manufacture); NUU (Other use, unclassified); PREP (Preparation); USES (Uses)
(production of alcs. by the hydrogenation of carbonyl compds.)

IT Carbonyl compounds (organic), reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(production of alcs. by the hydrogenation of carbonyl compds.)

IT 64-18-6, Formic acid, processes 64-19-7, Acetic acid, processes 1310-58-3, Potassium hydroxide, processes 1310-73-2, Sodium hydroxide, processes 1336-21-6, Ammonium hydroxide 7647-01-0, Hydrochloric acid, processes 7664-38-2, Phosphoric acid, processes

RL: PEP (Physical, engineering or chemical process); PROC (Process)
(activated carbon nonoxidizing pretreatment agent; procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

IT 7440-44-0, Activated carbon, uses
RL: CAT (Catalyst use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(activated; procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

IT 7439-89-6, Iron, uses 7439-96-5, Manganese, uses 7439-98-7, Molybdenum, uses 7440-02-0, Nickel, uses 7440-06-4, Platinum, uses 7440-15-5, Rhenium, uses 7440-18-8, Ruthenium, uses 7440-22-4, Silver, uses 7440-33-7, Tungsten, uses 7440-47-3, Chromium, uses 7440-50-8, Copper, uses 7440-57-5, Gold, uses 7440-62-2, Vanadium, uses 7440-66-6, Zinc, uses

RL: CAT (Catalyst use); USES (Uses)
(procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

IT 1314-68-7, Dirhenium heptoxide
RL: CAT (Catalyst use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

IT 629-11-8P, 1,6-Hexanediol 118562-73-5P
RL: IMF (Industrial manufacture); PREP (Preparation)

(procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

IT 96-48-0, .gamma.-Butyrolactone 108-30-5,
Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions
110-15-6, Succinic acid, reactions
110-16-7, Maleic acid, reactions
110-17-8, Fumaric acid, reactions 124-04-9, Adipic acid,
reactions 502-44-3, Caprolactone 1191-25-9, 6-Hydroxycaproic acid
178804-38-1
RL: RCT (Reactant); RACT (Reactant or reagent)
(procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

IT 7732-18-5, Water, uses
RL: NUU (Other use, unclassified); USES (Uses)
(washing solvent; procedure for the production of alcs. by the hydrogenation of carbonyl compds. using rhenium-and-platinum-containing catalyst with an activated carbon support)

L50 ANSWER 4 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
AN 2001:128171 HCAPLUS
DN 134:164831
ED Entered STN: 21 Feb 2001
TI Process for hydrogenation of maleic acid to 1,4-butanediol by using oxidized carbon-supported catalysts
IN Budge, John R.; Attig, Thomas G.; Dubbert, Robert A.
PA The Standard Oil Company, USA
SO Jpn. Kokai Tokkyo Koho, 30 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM B01J023-66
ICS B01J023-89; C07B061-00; C07C029-149; C07C031-20; C07D307-08
CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)
Section cross-reference(s): 23, 67

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---------------------|------|----------|-----------------|--------------|
| JP 2001046871 | A2 | 20010220 | JP 1999-219971 | 19990803 <-- |
| AU 772779 | B2 | 20040506 | AU 1999-43498 | 19990809 <-- |
| AU 9943498 | A1 | 20010215 | | |
| PRAI JP 1999-219971 | A | 19990803 | <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|---------------|-------|--|
| JP 2001046871 | ICM | B01J023-66 |
| | ICS | B01J023-89; C07B061-00; C07C029-149; C07C031-20; C07D307-08 |

AB Maleic acid, maleic anhydride and other hydrogenatable precursors are catalytically hydrogenated into 1,4-butanediol and THF by using a hydrogenation catalyst comprising palladium, silver, rhenium, and .gtoreq.1 aluminum, and/or cobalt on a carbon support, wherein the catalyst is prepared by (i) oxidizing the carbon support with an oxidizing agent; (ii) impregnating the treated support in .gtoreq.1 impregnation step comprising contacting the support with a source of palladium, silver, rhenium, and .gtoreq.1 aluminum, and/or cobalt, resp.; (iii) drying the impregnated support to remove solvent after each impregnation; and (iv) heating the dried support. The use of the catalyst in the process give a higher yield of 1,4-butanediol with minimal formation of .gamma.-butyrolactone byproduct.

ST butanediol THF prepn maleic anhydride hydrogenation; carbon support oxidized hydrogenation catalyst; palladium silver rhenium carbon supported catalyst; aluminum cobalt carbon supported catalyst

IT Catalyst supports

Hydrogenation

Hydrogenation catalysts

(process for hydrogenation of anhydrides or dicarboxylic acids to diol by using palladium, silver and rhenium on oxidized carbon supports)

IT 7440-44-0, Norit RX 1.5 Extra, uses
RL: CAT (Catalyst use); USES (Uses)
(activated, support; process for hydrogenation of anhydrides or dicarboxylic acids to diol by using palladium, silver and rhenium on oxidized carbon supports)

IT 7429-90-5, Aluminum, uses 7440-48-4, Cobalt, uses 7761-88-8, Silver nitrate, uses 7782-61-8, Ferric nitrate nonahydrate 10102-05-3.

Palladium nitrate 13768-11-1, Perrhenic acid
 RL: CAT (Catalyst use); USES (Uses)
 (process for hydrogenation of anhydrides or dicarboxylic acids to diol
 by using palladium, silver and rhenium on oxidized carbon supports)

IT 109-99-9P, THF, preparation 110-63-4P,
 1,4-Butanediol, preparation
 RL: IMF (Industrial manufacture); PREP (Preparation)
 (process for hydrogenation of anhydrides or dicarboxylic acids to diol
 by using palladium, silver and rhenium on oxidized carbon supports)

IT 96-48-0, .gamma.-Butyrolactone 106-65-0, Dimethyl succinate 108-30-5,
 Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions
 110-15-6, Succinic acid, reactions
 110-15-6D, Succinic acid, esters
 110-16-7, Maleic acid, reactions
 110-16-7D, Maleic acid, esters
 110-17-8, Fumaric acid, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (process for hydrogenation of anhydrides or dicarboxylic acids to diol
 by using palladium, silver and rhenium on oxidized carbon supports)

L50 ANSWER 5 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN

AN 1999:818952 HCPLUS

DN 132:50372

ED Entered STN: 30 Dec 1999

TI Ruthenium, rhenium, tin/carbon catalyst for hydrogenation in aqueous
 solution and hydrogenation therewith

IN Bockrath, Richard Edmond; Campos, Daniel; Schwartz, Jo-Ann Theresa;
 Stimek, Richard Thomas

PA E. I. Du Pont de Nemours & Co., USA

SO U.S., 10 pp.

CODEN: USXXAM

DT Patent

LA English

IC ICM C07D307-08

ICS C07D307-58; C07C027-04; C07C029-149

NCL 549508000

CC 35-2 (Chemistry of Synthetic High Polymers)

Section cross-reference(s): 67

FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|------|---------------|------|----------|-----------------|--------------|
| PI | US 6008384 | A | 19991228 | US 1998-33992 | 19980303 <-- |
| PRAI | US 1998-33992 | | 19980303 | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
|------------|-------|------------------------------------|

| | | |
|------------|-----|-------------------------------------|
| US 6008384 | ICM | C07D307-08 |
| | ICS | C07D307-58; C07C027-04; C07C029-149 |
| | NCL | 549508000 |

AB An improved two-step (dual-stage catalysis) aqueous hydrogenation process uses a novel trimetallic hydrogenation catalysts consisting essentially of highly dispersed, reduced ruthenium and rhenium metals in the presence of the third metal tin on carbon support, which is particularly useful in the second stage of the process. Such process and catalyst exhibit high conversion rates in aqueous solution hydrogenation of hydrogenatable precursors (e.g., maleic acid, succinic acid, corresponding esters, .gamma.-butyrolactone, etc.) to THF, .gamma.-butyrolactone, 1,4-butanediol and mixts. thereof wherein the relative molar ratio of 1,4-butanediol to THF products being produced can be controlled.

ST hydrogenation catalyst ruthenium rhenium tin carbon; maleic acid hydrogenation butanediol THF selectivity; succinic acid hydrogenation catalyst; butyrolactone prodn hydrogenation catalyst

IT Hydrogenation

(aqueous, two-step; of maleic and succinic acids in high conversion and controllability)

IT Hydrogenation catalysts
 (ruthenium, rhenium, tin/carbon; for maleic and succinic acids in high conversion and controllability)

IT 7440-15-5, Rhenium, uses

RL: CAT (Catalyst use); USES (Uses)
 (catalysts containing rhenium for hydrogenation of maleic and succinic acids)

IT 7440-18-8, Ruthenium, uses

RL: CAT (Catalyst use); USES (Uses)
 (catalysts containing ruthenium for hydrogenation of maleic and succinic acids)

IT 7440-31-5, Tin, uses
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts containing tin for hydrogenation of maleic and succinic acids)

IT 96-48-0P, .gamma.-Butyrolactone
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)
 (catalysts for hydrogenation and production of)

IT 109-99-9P, THF, preparation 110-63-4P,
 1,4-Butanediol, preparation
 RL: IMF (Industrial manufacture); PREP (Preparation)
 (hydrogenation catalysts for production from maleic and succinic acids)

IT 7440-44-0, Carbon, uses
 RL: CAT (Catalyst use); USES (Uses)
 (in catalysts for hydrogenation of maleic and succinic acids)

IT 110-15-6, Succinic acid, reactions
 110-15-6D, Succinic acid, esters
 110-16-7, Maleic acid, reactions
 110-16-7D, Maleic acid, esters
 110-17-8, Fumaric acid, reactions 110-17-8D, Fumaric acid, esters
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (ruthenium, rhodium, tin/carbon catalyst for hydrogenation with improved selectivity and yield)

RE.CNT 18 THERE ARE 18 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

- (1) Anon; JP 05-246915 1993 HCPLUS
- (2) Anon; JP 06-116182 1994 HCPLUS
- (3) Anon; JP 06-157490 1994 HCPLUS
- (4) Anon; JP 06-157491 1994 HCPLUS
- (5) Anon; JP 06-179667 1994 HCPLUS
- (6) Anon; JP 07-165644 1995 HCPLUS
- (7) Anon; JP 09-59190 1997 HCPLUS
- (8) Budge; US 5196602 1993 HCPLUS
- (9) Griffiths; US 4659686 1987 HCPLUS
- (10) Junichi, K; Bulletin Of The Japan Petroleum Institute 1970, V12, P89
- (11) Keith; US 3138560 1964 HCPLUS
- (12) Kitson; US 4985572 1991 HCPLUS
- (13) Kitson; US 5149680 1992 HCPLUS
- (14) Mabry; US 4550185 1985 HCPLUS
- (15) Mabry; US 4609636 1986 HCPLUS
- (16) Schwartz; US 5478952 1995 HCPLUS
- (17) Stabel; US 5073650 1991 HCPLUS
- (18) Ziemecki, S; Surface Mobility of Re2O7 in the System Re7+Pd0/y-A12O3 1986, P207 HCPLUS

L50 ANSWER 6 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1999:670143 HCPLUS
 DN 131:272328
 ED Entered STN: 21 Oct 1999
 TI Process and catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol
 IN Budge, John Raymond; Attig, Thomas George; Dubbert, Robert Allen
 PA The Standard Oil Company, USA
 SO U.S., 7 pp., Cont.-in-part of U.S. Ser. No. 781,945, abandoned.
 CODEN: USXXAM
 DT Patent
 LA English
 IC ICM C07D307-02
 NCL 549508000
 CC 35-2 (Chemistry of Synthetic High Polymers)
 Section cross-reference(s): 23, 67

FAN.CNT 2

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|-------------|------|----------|-----------------|--------------|
| US 5969164 | A | 19991019 | US 1998-56193 | 19980406 <-- |
| SG 74602 | A1 | 20000822 | SG 1997-3830 | 19971022 <-- |
| AU 9743631 | A1 | 19980625 | AU 1997-43631 | 19971029 <-- |
| AU 720496 | B2 | 20000601 | | |
| AT 262376 | E | 20040415 | AT 1997-310014 | 19971211 <-- |
| JP 10192709 | A2 | 19980728 | JP 1997-347597 | 19971217 <-- |

| | | | | |
|--|----|----------|------------------|--------------|
| CN 1185993 | A | 19980701 | CN 1997-108787 | 19971219 <-- |
| CN 1094791 | B | 20021127 | | |
| TW 415938 | B | 20001221 | TW 1997-86119385 | 19971219 <-- |
| EP 1077080 | A1 | 20010221 | EP 1999-306525 | 19990818 <-- |
| R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO | | | | |
| SG 84543 | A1 | 20011120 | SG 1999-4399 | 19990908 <-- |
| PRAI US 1996-781945 | B2 | 19961220 | | <-- |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
|------------|-------|------------------------------------|

| | | |
|------------|-----|------------|
| US 5969164 | ICM | C07D307-02 |
| | NCL | 549508000 |

AB A catalyst for the hydrogenation of maleic acid, maleic anhydride, or other hydrogenatable precursors (e.g., di-Me succinate) to 1,4-butanediol in high yield and selectivity is described which comprises palladium, silver, rhenium, and at least one of iron, aluminum, cobalt, or their mixts. all on a carbon support. The hydrogenation catalyst is prepared by first oxidizing the carbon support by contacting it with an oxidizing agent (e.g., nitric acid), followed by impregnating the oxidized support with a source of the catalytic metals, drying the impregnated support, and heating the dried support at 100-350.degree. under reducing conditions.

ST butanediol manuf maleic acid hydrogenation; hydrogenation catalyst maleic anhydride prepn butanediol

IT Oxidation

(of a carbon support in the preparation of a hydrogenation catalyst for the conversion of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT Hydrogenation

(of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT Reduction

(of metal-impregnated and dried carbon support in the preparation of catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT Hydrogenation catalysts

(palladium and silver and rhenium and at least one of iron and/or aluminum and/or cobalt and/or their mixts. all on a carbon support for the conversion of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 7429-90-5, Aluminum, uses 7439-89-6, Iron, uses 7440-05-3, Palladium, uses 7440-15-5, Rhenium, uses 7440-22-4, Silver, uses 7440-48-4, Cobalt, uses

RL: CAT (Catalyst use); USES (Uses)
(catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 7601-90-3, Perchloric acid, reactions 7681-52-9, Sodium hypochlorite
7697-37-2, Nitric acid, reactions 7722-84-1, Hydrogen peroxide,
reactions 7727-54-0, Ammonium persulfate

RL: RCT (Reactant); RACT (Reactant or reagent)
(in the preparation of catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 109-99-9P, Thf, preparation 110-63-4P,
1,4-Butanediol, preparation

RL: IMF (Industrial manufacture); PREP (Preparation)
(process and catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 96-48-0, .gamma.-Butyrolactone 106-65-0, Dimethyl succinate 108-30-5,
Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions
110-15-6, Succinic acid, reactions

110-15-6D, Succinic acid, esters

110-16-7, Maleic acid, reactions

110-16-7D, Maleic acid, esters

110-17-8, Fumaric acid, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)

(process and catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

IT 7440-44-0, Carbon, reactions

RL: CAT (Catalyst use); RCT (Reactant); RACT (Reactant or reagent); USES (Uses)

(support; catalysts for the hydrogenation of maleic acid or hydrogenatable precursors into 1,4-butanediol)

RE.CNT 1 THERE ARE 1 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

(1) Kitson; US 4985572 1991 HCPLUS

L50 ANSWER 7 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
 AN 1999:355604 HCAPLUS
 DN 130:352770
 ED Entered STN: 10 Jun 1999
 TI Process and catalysts for the hydrogenation of maleic acid or its derivatives into 1,4-butanediol
 IN Attig, Thomas George; Budge, John Raymond; Dubbert, Robert Allen
 PA The Standard Oil Company, USA
 SO Eur. Pat. Appl., 8 pp.
 CODEN: EPXXDW
 DT Patent
 LA English
 IC ICM C07C029-17
 ICS C07C029-149
 CC 35-2 (Chemistry of Synthetic High Polymers)
 Section cross-reference(s): 23, 48, 67
 FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|--|------|----------|------------------|--------------|
| PI EP 919530 | A1 | 19990602 | EP 1998-309711 | 19981126 <-- |
| EP 919530 | B1 | 20020213 | | |
| R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO | | | | |
| US 6486367 | B1 | 20021126 | US 1997-980542 | 19971201 <-- |
| AU 9891414 | A1 | 19990617 | AU 1998-91414 | 19981109 <-- |
| AU 756102 | B2 | 20030102 | | |
| SG 74671 | A1 | 20000822 | SG 1998-4651 | 19981111 <-- |
| ES 2172865 | T3 | 20021001 | ES 1998-309711 | 19981126 <-- |
| CN 1229072 | A | 19990922 | CN 1998-125255 | 19981130 <-- |
| CN 1110472 | B | 20030604 | | |
| MX 9810028 | A | 20000131 | MX 1998-10028 | 19981130 <-- |
| JP 11240846 | A2 | 19990907 | JP 1998-342228 | 19981201 <-- |
| TW 401317 | B | 20000811 | TW 1998-87119806 | 19990224 <-- |
| ZA 9904944 | A | 20000207 | ZA 1999-4944 | 19990802 <-- |
| PRAI US 1997-980542 | A | 19971201 | <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
| EP 919530 | ICM | C07C029-17 |
| | ICS | C07C029-149 |
| EP 919530 | ECLA | C07C029/17F |
| US 6486367 | ECLA | C07C029/17F |

AB 1,4-Butanediol is prepared in high yield and selectivity by the hydrogenation of maleic acid and/or its hydrogenatable precursors (e.g., .gamma.-butyrolactone, fumaric acid, succinic acid, etc.) in the presence of a platinum-group metal catalyst (e.g., Pd and Re); the production and yield of 1,4-butanediol is enhanced by the addition of 20-160 ppm of iron, in the form of an iron compound (e.g., iron acetate), to the hydrogenatable precursor feed.

ST butanediol manuf maleic acid hydrogenation; hydrogenation catalyst iron additive manuf butanediol

IT Platinum-group metals

RL: CAT (Catalyst use); USES (Uses)
(catalysts with iron compds. for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT Hydrogenation
(of maleic acid or its derivs. into 1,4-butanediol)

IT Hydrogenation catalysts
(platinum-group metals with iron compds. for the conversion of maleic acid or its derivs. into 1,4-butanediol)

IT 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-16-6,
Rhodium, uses 7440-18-8, Ruthenium, uses

RL: CAT (Catalyst use); USES (Uses)
(catalysts with iron compds. for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 7440-15-5, Rhenium, uses 7440-22-4, Silver, uses

RL: CAT (Catalyst use); USES (Uses)
(catalysts with platinum-group metals and iron compds. for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 2140-52-5, Iron acetate 7439-89-6, Iron, uses 14451-00-4, Iron fumarate 31516-56-0, Maleic acid iron salt 38781-07-6, Butanoic acid, iron salt 43212-87-9, Iron succinate 72535-95-6, Iron propionate

RL: CAT (Catalyst use); USES (Uses)
(catalysts with platinum-group metals for the hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

IT 110-63-4P, 1,4-Butanediol,

preparation
 RL: IMF (Industrial manufacture); PREP (Preparation)
 (process and catalysts for the hydrogenation of maleic acid or its
 derivs. into 1,4-butanediol)

IT 96-48-0, .gamma.-Butyrolactone 108-30-5, Succinic anhydride, reactions
 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic
 acid, reactions 110-15-6D, Succinic
 acid, di(C1-8 alkyl) esters 110-16-7, Maleic
 acid, reactions 110-16-7D, Maleic acid
 , di(C1-8 alkyl) esters 110-17-8, Fumaric acid, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (process and catalysts for the hydrogenation of maleic
 acid or its derivs. into 1,4-butanediol)

IT 7440-44-0, Carbon, uses
 RL: CAT (Catalyst use); USES (Uses)
 (support; catalysts with platinum-group metals and iron compds. for the
 hydrogenation of maleic acid or its derivs. into 1,4-butanediol)

RE.CNT 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS RECORD
 RE
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 (2) Hoechst; GB 1551741 A 1979 HCPLUS
 (3) Kitson, M; US 5149680 A 1992 HCPLUS

L50 ANSWER 8 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1998:178175 HCPLUS
 DN 128:197251
 ED Entered STN: 26 Mar 1998
 TI Catalyst for hydrogenation of carboxylic acids and manufacture thereof
 IN Kusaka, Haruhiko; Takahashi, Yuko; Yokotake, Ichiro
 PA Mitsubishi Chemical Industries Ltd., Japan
 SO Jpn. Kokai Tokkyo Koho, 12 pp.
 CODEN: JKXXAF
 DT Patent
 LA Japanese
 IC ICM B01J023-62
 ICS C07C029-157; C07D307-08; C07B061-00
 CC 67-2 (Catalysis, Reaction Kinetics, and Inorganic Reaction Mechanisms)

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---------------------|------|--------------|-----------------|--------------|
| PI JP 10071332 | A2 | 19980317 | JP 1996-193583 | 19960723 <-- |
| PRAI JP 1996-169427 | | 19960628 <-- | | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|-------------|-------|---|
| JP 10071332 | ICM | B01J023-62 ICS C07C029-157; C07D307-08; C07B061-00 |

AB The catalyst comprises combination of Ru and Sn, or other Group VIII elements in addition to Ru and Sn on a carbon-based support, wherein the catalyst is characterized by intensities of Ru when the catalyst is measured by using x-ray analyzer line anal. The process comprises allowing the carbon-based support such as activated char coal to react with nitric acid before adsorption of Ru and Sn on the support is carried out. The carboxylic acids may be selected from maleic anhydride, maleic acid, phthalic acid, succinic anhydride, succinic acid, and .gamma.-butyrolactone. The catalyst is designed for manufacture of 1,4-butanediol, THF, etc.

ST hydrogenation ruthenium tin catalyst; Group VIII element ruthenium tin catalyst; carbon based ruthenium tin catalyst

IT Charcoal
 RL: CAT (Catalyst use); USES (Uses)
 (activated; catalyst for hydrogenation of carboxylic acids from ruthenium and tin supported on carbon-based support)

IT Hydrogenation
 Hydrogenation catalysts
 (catalyst for hydrogenation of carboxylic acids from ruthenium and tin supported on carbon-based support)

IT 7440-18-8, Ruthenium, uses 7440-31-5, Tin, uses
 RL: CAT (Catalyst use); USES (Uses)
 (catalyst for hydrogenation of carboxylic acids from ruthenium and tin supported on carbon-based support)

IT 110-15-6, Succinic acid, reactions
 RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
 (catalyst for hydrogenation of carboxylic acids from ruthenium and tin

supported on carbon-based support)

IT 96-48-0P, .gamma.-Butyrolactone
109-99-9P, preparation 110-63-4P, 1,4
-Butanediol, preparation
RL: PNU (Preparation, unclassified); PREP (Preparation)
(catalyst for hydrogenation of carboxylic acids from ruthenium and tin supported on carbon-based support)

IT 7697-37-2, Nitric acid, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(catalyst for hydrogenation of carboxylic acids from ruthenium and tin supported on carbon-based support)

L50 ANSWER 9 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
AN 1998:85191 HCPLUS
DN 128:217030
ED Entered STN: 13 Feb 1998
TI Dihydrogen reduction of nitroorganics, alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts
AU Islam, S. M.; Bose, A.; Palit, B. K.; Saha, C. R.
CS Department of Chemistry, Indian Institute of Technology, Kharagpur, 721302, India
SO Journal of Catalysis (1998), 173(2), 268-281
CODEN: JCTLAS; ISSN: 0021-9517
PB Academic Press
DT Journal
LA English
CC 22-7 (Physical Organic Chemistry)
Section cross-reference(s): 35, 67
AB Complexation of Schiff bases derived from the condensation of aminopolystyrene and carbonyl compds., PhCOR (R = H, CH₃, C₆H₅) with palladium(II) acetate results in the formation of acetato-bridged, dinuclear orthopalladated complexes anchored to macroporous polystyrene beads. Hydrogen activation of the material at 80.degree.C in DMF suspension brings the reduction of coordinated azomethine group with simultaneous replacement of the bridged acetate by H and DMF, producing the corresponding mononuclear secondary amine complexes. The activated species are highly active towards the dihydrogen reduction of aromatic nitro- and carbonyl compds., alkenes, alkynes, and Schiff bases under normal pressure at ambient temperature in aprotic solvents like DMF, DMSO, Et acetate, and THF. The highest activity was observed with R = H in a DMF medium. Similar polystyrene-based orthometalated secondary amine complexes of palladium(II) prepared by alternative methods exhibit comparable catalytic activities. The same specimen of the catalyst can be used repeatedly for the reduction of the same or different substrates under comparable reaction conditions and stored indefinitely without any loss of catalytic activity. A tentative reduction mechanism has been suggested on the basis of catalyst transformation, identification of the intermediates at various stages of reaction, and kinetic studies.
ST polymer supported palladium redn catalyst; nitro org redn polymer supported palladium; alkene polymer supported palladium; alkyne polymer supported palladium; Schiff base polymer supported palladium
IT Aldehydes, reactions
Nitro compounds
RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(aromatic; dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)
IT Hydrogenation
Hydrogenation catalysts
Hydrogenation kinetics
Polymer-supported reagents
Substituent effects
(dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)
IT Alkenes, reactions
Alkynes
Schiff bases
RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)
IT Aromatic compounds

RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
 (nitro; dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 7440-05-3, Palladium, uses
 RL: CAT (Catalyst use); USES (Uses)
 (charcoal-supported Pd vs. polymer-supported Pd complexes; dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 196091-85-7DP, polymer-supported 196091-86-8DP, polymer-supported 196091-87-9DP, polymer-supported
 RL: CAT (Catalyst use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)
 (dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 98-86-2DP, Acetophenone, reaction products with p-aminopolystyrene, palladium(II) complexes 100-44-7DP, Benzyl chloride, reaction products with p-aminopolystyrene, palladium(II) complexes 100-52-7DP, Benzaldehyde, reaction products with p-aminopolystyrene, palladium(II) complexes, preparation 119-61-9DP, Benzophenone, reaction products with p-aminopolystyrene, palladium(II) complexes 9003-53-6DP, Polystyrene, p-aminated, Schiff base reaction products, palladium(II) complexes
 RL: CAT (Catalyst use); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)
 (dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 78-79-5, Isoprene, reactions 86-57-7, 1-Nitronaphthalene 88-72-2, o-Nitrotoluene 88-73-3, o-Chloronitrobenzene 98-95-3, Nitrobenzene, reactions 99-65-0, m-Dinitrobenzene 99-99-0, p-Nitrotoluene 100-00-5, p-Chloronitrobenzene 100-25-4, p-Dinitrobenzene 100-52-7, Benzaldehyde, reactions 102-96-5, .omega.-Nitrostyrene 110-16-7, Maleic acid, reactions 110-17-8, Fumaric acid, reactions 110-83-8, Cyclohexene, reactions 501-65-5, Diphenylacetylene 536-74-3, Phenylacetylene 538-51-2, Benzylideneaniline 592-41-6, 1-Hexene, reactions 610-93-5, 6-Nitrophthalide 622-29-7, N-Methylbenzaldimine 26791-93-5, Methyl 4,5-dimethoxy-2-nitrobenzoate
 RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
 (dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 100-42-5P, Styrene, reactions
 RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); PROC (Process); RACT (Reactant or reagent)
 (dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 6418-00-4P
 RL: PEP (Physical, engineering or chemical process); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); PROC (Process); RACT (Reactant or reagent)
 (dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 39963-25-2DP, polymer-supported 39963-30-9DP, polymer-supported 39963-33-2DP, polymer-supported 204200-62-4DP, polymer-supported
 RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)
 (dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases using polymer-anchored orthometalated Schiff-base complexes of palladium(II) as catalysts)

IT 62-53-3P, Aniline, preparation 78-78-4P, 2-Methylbutane 95-51-2P, o-Chloroaniline 95-53-4P, o-Toluidine, preparation 100-41-4P, Ethylbenzene, preparation 100-51-6P, Benzyl alcohol, preparation 103-29-7P, 1,2-Diphenylethane 103-32-2P, N-Phenylbenzylamine 103-67-3P, N-Methylbenzylamine 106-47-8P, p-Chloroaniline, preparation 106-49-0P, p-Toluidine, preparation 106-50-3P, p-Phenylenediamine, preparation 108-45-2P, 1,3-Benzenediamine, preparation 110-15-6P, Succinic acid, preparation 110-54-3P, Hexane, preparation 110-82-7P, Cyclohexane, preparation 134-32-7P,

1-Aminonaphthalene 6125-24-2P, .omega.-Nitroethylbenzene 26759-46-6P,
 Methyl 2-amino-4,5-dimethoxybenzoate 57319-65-0P, 6-Aminophthalide
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (dihydrogen reduction of nitroorgs., alkenes, alkynes, and Schiff bases
 using polymer-anchored orthometalated Schiff-base complexes of
 palladium(II) as catalysts)

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L50 ANSWER 10 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1998:1355 HCPLUS
 DN 128:63169
 ED Entered STN: 02 Jan 1998
 TI Catalysts for the hydrogenation of aqueous solutions of maleic acid and
 its derivatives into 1,4-butanediol
 IN Pedersen, S. Erik; Frye, John G., Jr.; Attig, Thomas G.; Budge, John R.
 PA Standard Oil Co., USA
 SO U.S., 7 pp.

CODEN: USXXAM
 DT Patent
 LA English
 IC ICM C07C029-149
 ICS C07D307-08
 NCL 568864000
 CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)
 Section cross-reference(s): 23, 48, 67

FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|------|-----------------------------------|------|----------|------------------|--------------|
| PI | US 5698749 | A | 19971216 | US 1995-524195 | 19950906 <-- |
| | EP 881203 | A1 | 19981202 | EP 1997-303664 | 19970530 <-- |
| | EP 881203 | B1 | 20010919 | | |
| | R: AT, BE, DE, ES, FR, GB, IT, NL | | | | |
| | AT 205820 | E | 20011015 | AT 1997-303664 | 19970530 <-- |
| | ES 2164992 | T3 | 20020301 | ES 1997-303664 | 19970530 <-- |
| | TW 419456 | B | 20010121 | TW 1997-86114367 | 19971002 <-- |
| PRAI | US 1995-524195 | A | 19950906 | <-- | |
| | EP 1997-303664 | A | 19970530 | <-- | |

CLASS

| | PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|--|------------|-------|------------------------------------|
| | US 5698749 | ICM | C07C029-149 |
| | | ICS | C07D307-08 |
| | | NCL | 568864000 |

AB Maleic acid, maleic anhydride and its other hydrogenatable derivs. (e.g., fumaric acid, succinic acid, etc.) are catalytically hydrogenated into 1,4-butanediol with reduced formation of THF and .gamma.-butyrolactone when the hydrogenation catalyst comprises .gtoreq.1 noble metal of Group VIII and .gtoreq.1 of Re, W, or Mo on a carbon support, which support has been contacted with an oxidizing agent prior to deposition of the metals. These catalysts are prepared by: (i) oxidizing the carbon support by contacting it with an oxidizing agent (e.g., HNO₃, H₂O₂, HClO₄, etc.); (ii) impregnating the treated support in .gtoreq.1 impregnation step(s); (iii) drying; and (i.v.) heating the dried, impregnated support under reducing conditions.

ST butanol prepn maleic anhydride hydrogenation; catalyst hydrogenation prepn

IT **Hydrogenation catalysts**
 (Group VIII elements and Re and/or W and/or Mo on an oxidant-treated carbon support for the conversion of aqueous solns. of maleic acid and its derivs. to 1,4-butanediol)

IT Group VIII elements
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. to 1,4-butanediol)

IT **Hydrogenation**
 (of aqueous solns. of maleic acid and its derivs. to 1,4-butanediol)

IT 7439-98-7, Molybdenum, uses 7440-15-5, Rhenium, uses 7440-33-7,
 Tungsten, uses 7440-44-0, Carbon, uses
 RL: CAT (Catalyst use); USES (Uses)
 (process and catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. into 1,4-butanediol)

IT 110-63-4P, 1,4-Butanediol,
 preparation
 RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)
 (process and catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. into 1,4-butanediol)

IT 96-48-0, .gamma.-Butyrolactone 106-65-0, Dimethyl succinate 108-30-5,
 Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions
 110-15-6, Succinic acid, reactions
 110-16-7, Maleic acid, reactions
 110-17-8, Fumaric acid, reactions 7601-90-3, Perchloric acid,
 reactions 7681-52-9, Sodium hypochlorite 7697-37-2, Nitric acid,
 reactions 7722-84-1, Hydrogen peroxide, reactions 7727-54-0, Ammonium persulfate
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (process and catalysts for the hydrogenation of aqueous solns. of maleic acid and its derivs. into 1,4-butanediol)

L50 ANSWER 11 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1997:528934 HCPLUS

DN 127:150390

ED Entered STN: 20 Aug 1997

TI Synthesis of .gamma.-butyrolactone by the

hydrogenation of maleic anhydride and its derivatives. Catalytic properties of ruthenium complex catalysts and the effect of additives

AU He, Dehua; Zhu, Qiming; Wakasa, Noriko; Fuchikami, Takamasa

CS State Key Lab. C1 Chem. & Technology, Dep. Chem., Tsinghua Univ., Beijing, 100084, Peop. Rep. China

SO Shiyou Huagong (1997), 26(7), 425-429

CODEN: SHHUE8; ISSN: 1000-8144

PB Beijing Huagong Yanjiuyuan

DT Journal

LA Chinese

CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)

Section cross-reference(s): 35, 67

AB The catalytic properties of Ru complex catalysts for the hydrogenation of maleic anhydride and its derivs. to .gamma.-butyrolactone (I) were investigated by using a portable autoclave. The effect of acid derivs. on the formation of I was studied. Ru-phosphine complex catalysts have a good activity for the formation of I. The addition of acids promotes the formation of I. Effects of solvents and reaction conditions (reaction temperature, hydrogen pressure and reaction time) was also studied.

ST ruthenium catalyst hydrogenation maleic anhydride deriv; phosphine ruthenium catalyst hydrogenation maleic anhydride; solvent hydrogenation maleic anhydride deriv

IT Hydrogenation

Hydrogenation catalysts
(synthesis of .gamma.-butyrolactone by hydrogenation of maleic anhydride (derivs.) with Ru complex catalysts and effects of additives for catalysts on hydrogenation)

IT Solvent effect
(synthesis of .gamma.-butyrolactone by hydrogenation of maleic anhydride (derivs.) with Ru complex catalysts and solvent effects on hydrogenation)

IT 96-48-0P, .gamma.-Butyrolactone
RL: IMF (Industrial manufacture); PREP (Preparation)
(synthesis of .gamma.-butyrolactone by hydrogenation of maleic anhydride (derivs.) with Ru complex catalysts and effects of additives for catalysts on hydrogenation)

IT 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions 110-16-7, Maleic acid, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(synthesis of .gamma.-butyrolactone by hydrogenation of maleic anhydride (derivs.) with Ru complex catalysts and effects of additives for catalysts on hydrogenation)

IT 75-75-2, Methanesulfonic acid 98-11-3, Benzenesulfonic acid, uses 104-15-4, p-Methylbenzenesulfonic acid, uses 998-40-3, Tributylphosphine 1303-86-2, Boron oxide, uses 1314-23-4, Zirconia, uses 1663-45-2 4731-53-7, Trioctylphosphine 7631-86-9, Silica, uses 7664-38-2, Phosphoric acid, uses 7688-25-7 10049-08-8, Ruthenium trichloride 13463-67-7, Titania, uses 14284-93-6, Tris(acetylacetato)ruthenium 14808-79-8, Sulfate ion, uses 15243-33-1, Dodecacarbonyltriruthenium 15529-49-4, Dichlorotris(triphenylphosphine)ruthenium 17440-81-2, Triethylammonium 22594-69-0, Bis(tricarbonyldichlororuthenium)
RL: CAT (Catalyst use); USES (Uses)
(synthesis of .gamma.-butyrolactone by hydrogenation of maleic anhydride (derivs.) with Ru complex catalysts and solvent effects on hydrogenation)

L50 ANSWER 12 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
AN 1996:658689 HCPLUS
DN 125:300815
ED Entered STN: 07 Nov 1996
TI Hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts
IN Kusaka, Haruhiko; Inagaki, Hiroko
PA Mitsubishi Chemical Corp., Japan
SO Jpn. Kokai Tokkyo Koho, 8 pp.
CODEN: JKXXAF

DT Patent
LA Japanese
IC ICM C07C031-20
ICS B01J023-656; C07C029-147; C07D307-08; C07D307-33
ICA C07B061-00
CC 27-6 (Heterocyclic Compounds (One Hetero Atom))
Section cross-reference(s): 45, 67

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|------------|------|------|-----------------|------|
|------------|------|------|-----------------|------|

| | | | | | |
|------|---------------|----|----------|---------------|--------------|
| PI | JP 08217707 | A2 | 19960827 | JP 1995-52020 | 19950217 <-- |
| PRAI | JP 1995-52020 | | | 19950217 <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
|------------|-------|------------------------------------|

| | | |
|-------------|-----|--|
| JP 08217707 | ICM | C07C031-20 |
| | ICS | B01J023-656; C07C029-147; C07D307-08; C07D307-33 |
| | ICA | C07B061-00 |

AB Carboxylic acids are hydrogenated with catalysts prepared by supporting colloidal Group VIII noble metal ingredients and (colloidal) Re ingredients on carriers and reducing before and/or after the supporting. A mixture of PdCl₂ and PVP in MeOH-H₂O was refluxed for 3 h, supported on activated C, calcined at 200.degree. for 2 h, and hydrogenated at 300.degree. for 2 h. Re₂O₇ was supported on the Pd/C and hydrogenated at 300.degree. for 2 h to prepare 1% Pd-3% Re/C, which was used in hydrogenation of maleic anhydride at 240.degree. for 2 h to give THF and .gamma.-butyrolactone with 17.5 and 73.2% selectivity, resp., at 66.0% conversion.

ST maleate hydrogenation catalyst palladium rhenium; THF prepn maleate hydrogenation catalyst; butyrolactone prepn maleate hydrogenation catalyst; carboxylate hydrogenation catalyst palladium rhenium

IT Hydrogenation

Hydrogenation catalysts

(hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT Group VIII elements

RL: CAT (Catalyst use); USES (Uses)
(hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT Carboxylic acids, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT Alcohols, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(reducing agents in catalyst preparation; hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT Polymers, uses

RL: CAT (Catalyst use); USES (Uses)
(water-soluble, protective colloids in catalyst preparation; hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT Alcohols, uses

RL: CAT (Catalyst use); USES (Uses)
(lower, protective colloids in catalyst preparation; hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT Colloids

(protective, in catalyst preparation; hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT 7439-88-5, Iridium, uses 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-15-5, Rhenium, uses 7440-16-6, Rhodium, uses 7440-18-8, Ruthenium, uses

RL: CAT (Catalyst use); USES (Uses)
(hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT 109-99-9P, THF, preparation 110-63-4P,

1,4-Butanediol, preparation

RL: IMF (Industrial manufacture); PREP (Preparation)
(hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT 96-48-0P, .gamma.-Butyrolactone

RL: IMF (Industrial manufacture); RCT (Reactant); PREP
(Preparation); RACT (Reactant or reagent)
(hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions

110-16-7, Maleic acid, reactions

110-17-8, Fumaric acid, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

IT 107-19-7, Propargyl alcohol 7722-84-1, Hydrogen peroxide, uses

9003-39-8, Poly(N-vinyl-2-pyrrolidone)

RL: CAT (Catalyst use); USES (Uses)

(protective colloid in catalyst preparation; hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)
IT 50-00-0, Formaldehyde, reactions 64-18-6, Formic acid, reactions
302-01-2, Hydrazine, reactions 1333-74-0, Hydrogen, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(reducing agent in catalyst preparation; hydrogenation of carboxylic acids with Group VIII metal-rhenium catalysts)

L50 ANSWER 13 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN

AN 1995:785396 HCPLUS

DN 123:227624

ED Entered STN: 12 Sep 1995

TI Manufacture of 1,4-butanediol and/or tetrahydrofuran

IN Hara, Yoshinori; Endo, Koetsu; Kusaka, Haruhiko

PA Mitsubishi Kagaku KK, Japan

SO Jpn. Kokai Tokkyo Koho, 5 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM C07C031-20

ICS B01J023-62; C07C029-136; C07D307-08

ICA C07B061-00

CC 23-7 (Aliphatic Compounds)

Section cross-reference(s): 27, 67

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---------------------|-------|----------|-----------------|--------------|
| ----- | ----- | ----- | ----- | ----- |
| PI JP 07165644 | A2 | 19950627 | JP 1994-255500 | 19941020 <-- |
| PRAI JP 1993-265076 | | 19931022 | | <-- |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|-------------|----------------|---|
| ----- | ----- | ----- |
| JP 07165644 | ICM C07C031-20 | ICS B01J023-62; C07C029-136; C07D307-08 |
| | ICA C07B061-00 | |

OS CASREACT 123:227624

AB Title compds. are manufactured by catalytic hydrogenation of .gtoreq.1 compound selected from maleic anhydride, maleic acid, succinic anhydride, succinic acid, and .gamma.-butyrolactone in the presence of a supported catalyst containing Sn and .gtoreq.1 of Ru, Pt, and Rh. Thus, autoclaving an aqueous solution of maleic anhydride and Ru(6.1%)-Pt(1.7%)-Sn(5%)/SiO₂ at 240.degree. and H pressure 100 kg/cm² gave reaction products containing THF 61.9, .gamma.-butyrolactone 13.1, and 1,4-butanediol 11.9 mol% with 98.3% conversion of the maleic anhydride.

ST butanediol manuf; THF manuf; maleic anhydride hydrogenation; succinic anhydride hydrogenation; butyrolactone hydrogenation; ruthenium platinum rhodium tin catalyst; noble metal tin hydrogenation catalyst

IT Hydrogenation
(of maleic anhydride to butanediol and/or THF)

IT Hydrogenation catalysts
(ruthenium-tin/silica or noble metal-tin/silica for maleic anhydride to butanediol and/or THF)

IT 7440-06-4P, Platinum, preparation

RL: CAT (Catalyst use); IMF (Industrial manufacture); SPN
(Synthetic preparation); PREP (Preparation); USES (Uses)
(catalyst, containing ruthenium and tin, supported on silica; catalysts for hydrogenation of maleic anhydride to butanediol and/or THF)

IT 7440-18-8P, Ruthenium, preparation

RL: CAT (Catalyst use); IMF (Industrial manufacture); SPN
(Synthetic preparation); PREP (Preparation); USES (Uses)
(catalysts, containing platinum and tin, supported on silica; catalysts for hydrogenation of maleic anhydride to butanediol and/or THF)

IT 7440-16-6P, Rhodium, preparation

RL: CAT (Catalyst use); IMF (Industrial manufacture); SPN
(Synthetic preparation); PREP (Preparation); USES (Uses)
(catalysts, containing ruthenium and tin, supported on silica; catalysts for hydrogenation of maleic anhydride to butanediol and/or THF
)

IT 7440-31-5P, Tin, preparation

RL: CAT (Catalyst use); IMF (Industrial manufacture); SPN
(Synthetic preparation); PREP (Preparation); USES (Uses)
(catalysts, containing ruthenium or platinum or rhodium, supported on

silica; catalysts for hydrogenation of maleic anhydride to butanediol and/or THF)
IT 110-15-6, Succinic acid, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation to butanediol)
IT 96-48-0, .gamma.-Butyrolactone 108-30-5,
Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions
110-16-7, Maleic acid, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation to butanediol and/or THF)
IT 109-99-9P, Tetrahydrofuran, preparation
110-63-4P, 1,4-Butanediol,
preparation
RL: IMF (Industrial manufacture); SPN (Synthetic
preparation); PREP (Preparation)
(preparation by hydrogenation of maleic anhydride)
IT 7631-86-9, Silica, uses
RL: CAT (Catalyst use); USES (Uses)
(supports for hydrogenation catalysts)

L50 ANSWER 14 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
AN 1995:615302 HCAPLUS

DN 123:9328

ED Entered STN: 16 Jun 1995

TI Preparation of lactone by hydrogenation of dicarboxylic acid

IN Sato, Akira; Koga, Kazuya; Myake, Takanori

PA Tosoh Corp, Japan; Sagami Chem Res

SO Jpn. Kokai Tokkyo Koho, 5 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM C07D307-33

ICS B01J031-24; C07D309-30; C07D313-00

ICA C07B061-00

CC 27-6 (Heterocyclic Compounds (One Hetero Atom))

FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---------------------|------|----------|-----------------|--------------|
| PI JP 07082260 | A2 | 19950328 | JP 1993-228695 | 19930914 <-- |
| PRAI JP 1993-228695 | | 19930914 | <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|-------------|-------|------------------------------------|
| JP 07082260 | ICM | C07D307-33 |
| | ICS | B01J031-24; C07D309-30; C07D313-00 |
| | ICA | C07B061-00 |

OS CASREACT 123:9328

AB A lactone, useful as a solvent or an intermediate for pyrrolidone and other chems., is prepared by liquid-phase homogeneous catalytic hydrogenation of a dicarboxylic acid in the presence of a Ru catalyst and an organic diphosphine compound. The preferred dicarboxylic acid is

maleic acid and/or succinic acid and

the corresponding lactone is .gamma.-

butyrolactone. Due to the presence of an organic diphosphine compound, this process does not require complicated reaction procedures, maintains high catalyst activity, and gives a lactone in high yield. Thus,

maleic acid 116, (Ph₃P)₃RuCl₂ 2.9, Ph₂P(CH₂)₄PPh₂ 2.6

mg, and 1 mL tetraglyme were placed in an autoclave and after thoroughly purging the system with H, pressurized with H at 50 kg/cm² G, and heated with stirring at 200.degree. for 2 h to give .gamma.-

butyrolactone 72.3, 1,4-butanediol

11.3, and propionic acid 2.1 mol%. Other diphosphine compds. such as Ph₂P(CH₂)₃PPh₂, (R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl [(R)-(+)-BINAP], 1,1'-bis(diphenylphosphino)ferrocene, and 1-[1',2-bis(diphenylphosphino)ferrocenyl]ethyl acetate were used instead of Ph₂P(CH₂)₄PPh₂ to give .gamma.-butyrolactone in 73.7, 67.9, 53.2, and 57.6% yield, resp., 1,4-

butanediol 4.6, 6.7, 0.0, 0.0, and 0.0%, resp., and propionic acid

6.3, 0.3, 0.6, and 0.7%, resp.

ST lactone hydrogenation dicarboxylic acid; ruthenium hydrogenation catalyst; org diphosphine hydrogenation catalyst

IT Hydrogenation

(preparation of lactone by hydrogenation of dicarboxylic acid)

IT Hydrogenation catalysts

(ruthenium compound and organic diphosphine for preparation of lactone by hydrogenation of dicarboxylic acid)

IT 79-09-4P, Propionic acid, preparation 110-63-4P, 1,
 4-Butanediol, preparation
 RL: BYP (Byproduct); PREP (Preparation)
 (preparation of lactone by hydrogenation of dicarboxylic acid in presence of
 ruthenium compound and organic diphosphine)

IT 6737-42-4, 1,3-Bis(diphenylphosphino)propane 7688-25-7,
 1,4-Bis(diphenylphosphino)butane 12150-46-8, 1,1'-
 Bis(diphenylphosphino)ferrocene 15529-49-4,
 Dichlororotris(triphenylphosphine)ruthenium 62412-57-1 76189-55-4,
 (R)-(+)-BINAP
 RL: CAT (Catalyst use); USES (Uses)
 (preparation of lactone by hydrogenation of dicarboxylic acid in presence of
 ruthenium compound and organic diphosphine)

IT 110-15-6, Succinic acid, reactions
 110-16-7, Maleic acid, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (preparation of lactone by hydrogenation of dicarboxylic acid in presence of
 ruthenium compound and organic diphosphine)

IT 96-48-0P, .gamma.-Butyrolactone
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of lactone by hydrogenation of dicarboxylic acid in presence of
 ruthenium compound and organic diphosphine)

L50 ANSWER 15 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
 AN 1994:658518 HCAPLUS
 DN 121:258518
 ED Entered STN: 26 Nov 1994
 TI Process of vapor phase catalytic hydrogenation of maleic anhydride to
 gamma-butyrolactone with activated copper-zinc-alumina-
 graphite catalyst
 IN Taylor, Paul D.; De Thomas, Waldo; Buchanan, Donald W., Jr.
 PA ISP Investments Inc., USA
 SO U.S., 6 pp. Cont.-in-part of U.S. Ser. No. 521,065, abandoned.
 CODEN: USXXAM
 DT Patent
 LA English
 IC ICM C07D307-33
 NCL 549325000
 CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)
 Section cross-reference(s): 27, 35

FAN.CNT 2

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|------|--|------|----------|-----------------|--------------|
| PI | US 5347021 | A | 19940913 | US 1991-656388 | 19910219 <-- |
| | CA 2080123 | AA | 19911017 | CA 1991-2080123 | 19910408 <-- |
| | WO 9116132 | A1 | 19911031 | WO 1991-US2389 | 19910408 <-- |
| | W: AU, CA, JP, KR | | | | |
| | RW: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, NL, SE | | | | |
| | AU 9176576 | A1 | 19911111 | AU 1991-76576 | 19910408 <-- |
| | AU 642250 | B2 | 19931014 | | |
| | JP 05505975 | T2 | 19930902 | JP 1991-507658 | 19910408 <-- |
| | EP 593458 | A1 | 19940427 | EP 1991-908530 | 19910408 <-- |
| | EP 593458 | B1 | 19960327 | | |
| | R: AT, BE, CH, DE, DK, ES, FR, GB, IT, LI, LU, NL, SE | | | | |
| | AT 135938 | E | 19960415 | AT 1991-908530 | 19910408 <-- |
| | ES 2085992 | T3 | 19960616 | ES 1991-908530 | 19910408 <-- |
| PRAI | US 1990-521065 | | 19900416 | <-- | |
| | US 1991-656388 | | 19910219 | <-- | |
| | WO 1991-US2389 | | 19910408 | <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
| US 5347021 | ICM | C07D307-33 |
| | NCL | 549325000 |

AB The vapor phase catalytic hydrogenation of maleic anhydride to
 gamma-butyrolactone is achieved (>95% conversion; >80%
 selectivity) during a prolonged period of production. The process uses an
 activated catalyst prepared by reducing a catalyst composition comprising 30-65%
 by weight of CuO, 18-50% by weight of ZnO and 8-22% by weight of Al2O3, and
 activating the reduced catalyst composition in hydrogen at an activation temperature
 of at least 400.degree.C, preferably 400.degree. to 525.degree.C, and
 optimally about 425.degree.C. The process suitably is carried out under
 predetd. and advantageous process conditions, including a defined molar
 ratio of hydrogen to maleic anhydride in the vapor reactant stream, a
 selected pressure during hydrogenation, a defined feed rate space
 velocity, a predetd. contact time, and a suitable reaction temperature

ST vapor phase hydrogenation maleic anhydride; **butyrolactone furanone dihydro**
 IT **Hydrogenation catalysts**
 (vapor phase hydrogenation catalysts; process vapor phase hydrogenation of maleic anhydride to **.gamma.-butyrolactone**)
 IT **Hydrogenation**
 (vapor phase hydrogenation; process vapor phase hydrogenation of maleic anhydride to **.gamma.-butyrolactone**)
 IT 1314-13-2, Zinc oxide (ZnO), processes 1317-38-0, Copper oxide (CuO), processes 1344-28-1, Aluminum oxide (Al2O3), processes 7782-42-5, Graphite, processes
 RL: CAT (Catalyst use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
 (copper-zinc-alumina-graphite catalyst; process vapor phase hydrogenation of maleic anhydride to **.gamma.-butyrolactone**)
 IT 1333-74-0
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation, vapor phase hydrogenation; process vapor phase hydrogenation of maleic anhydride to **.gamma.-butyrolactone**)
 IT 110-16-7, Maleic acid, reactions
 RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
 (process vapor phase hydrogenation of maleic acid to **.gamma.-butyrolactone**)
 IT 96-48-0P, **.gamma.-Butyrolactone**
 RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
 (process vapor phase hydrogenation of maleic anhydride to **.gamma.-butyrolactone**)
 IT 108-31-6, Maleic anhydride, reactions
 RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
 (process vapor phase hydrogenation of maleic anhydride to **.gamma.-butyrolactone**)
 IT 110-15-6, Succinic acid, reactions
 RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
 (process vapor phase hydrogenation of succinic acid to **.gamma.-butyrolactone**)
 IT 108-30-5, Succinic anhydride, reactions
 RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
 (process vapor phase hydrogenation of succinic anhydride to **.gamma.-butyrolactone**)

L50 ANSWER 16 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
 AN 1994:457326 HCAPLUS
 DN 121:57326
 ED Entered STN: 06 Aug 1994
 TI Manufacture of lactones
 IN Fuchigami, Takamasa; Wakasa, Noriko; Ka, Tokuka; Okada, Takashi;
 Sasakihara, Hiroyuki; Fujimura, Atsushi; Myake, Takanori; Kano, Yoshiaki;
 Saito, Toshihiro
 PA Tosoh Corp, Japan; Sagami Chem Res
 SO Jpn. Kokai Tokkyo Koho, 5 pp.
 CODEN: JKXXAF

DT Patent
 LA Japanese
 IC ICM C07D307-33
 ICS B01J023-44; C07D309-30
 ICA C07B061-00
 CC 27-6 (Heterocyclic Compounds (One Hetero Atom))
 FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|--------------------|------|----------|-----------------|--------------|
| PI JP 06041106 | A2 | 19940215 | JP 1992-56520 | 19920210 <-- |
| PRAI JP 1992-56520 | | 19920210 | | |

CLASS
 PATENT NO. CLASS PATENT FAMILY CLASSIFICATION CODES
 ----- ----- -----
 JP 06041106 ICM C07D307-33
 ICS B01J023-44; C07D309-30
 ICA C07B061-00

OS CASREACT 121:57326
 AB Lactones are manufactured by hydrogenating saturated and/or unsatd. dicarboxylic acid derivs. in the presence of supported noble metals of VIII group as catalyst and inorg. alkali metal salts and the process is applied to succinic acid and/or maleic acid derivs. to give .gamma.-butyrolactone. Thus, maleic anhydride was hydrogenated in dimethoxyethane in the presence of Pd(5%)/C and Cs₂SO₄ at 180.degree. and H pressure 50 kg/cm² gauge for 16 h to give 97 mol% .gamma.-butyrolactone.
 ST lactone prep; butyrolactone prep; dicarboxylate hydrogenation noble metal catalyst; alkali metal catalyst hydrogenation dicarboxylate; succinic acid hydrogenation; maleic acid hydrogenation
 IT Hydrogenation catalysts
 (Group VIII metals and alkali metal salts, for dicarboxylates to lactones)
 IT Group VIII elements
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts, containing alkali metal salts, for hydrogenation of dicarboxylates, to lactones)
 IT Hydrogenation
 (of dicarboxylates, to lactones)
 IT Lactones
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of dicarboxylates)
 IT Carboxylic acids, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (di-, hydrogenation of, lactones from)
 IT Alkali metals, uses
 RL: USES (Uses)
 (salts, catalysts containing Group VIII elements and, for hydrogenation of dicarboxylates to lactones)
 IT 7440-05-3, Palladium, uses
 RL: CAT (Catalyst use); USES (Uses)
 (catalyst, supported on activated carbon, containing alkali metal salts, for hydrogenation of dicarboxylates to lactones)
 IT 10294-54-9, Cesium sulfate
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (catalysts containing VIII group elements and, for hydrogenation of dicarboxylates to lactones)
 IT 108-31-6, 2,5-Furandione, reactions 110-16-7, 2-
 Butenedioic acid (Z)-, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation of, .gamma.-butyrolactone from)
 IT 1318-93-0, Montmorillonite, uses
 RL: USES (Uses)
 (potassium-exchanged, catalysts containing VIII group elements and, for hydrogenation of dicarboxylates to lactones)
 IT 96-48-0P, .gamma.-Butyrolactone
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of maleic anhydride, VIII group elements and alkali metal salts as catalysts for)

L50 ANSWER 17 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1994:134267 HCPLUS
 DN 120:134267
 ED Entered STN: 19 Mar 1994
 TI Preparation of lactones by hydrogenation
 IN Fuchigami, Takamasa; Wakasa, Noriko; Iwai, Noriharu; Sasakihara, Hiroyuki; Okada, Takashi; Fujimura, Atsushi; Myake, Takanori; Kano, Yoshiaki; Saito, Toshihiro
 PA Tosoh Corp, Japan; Sagami Chem Res
 SO Jpn. Kokai Tokkyo Koho, 7 pp.
 CODEN: JKXXAF
 DT Patent
 LA Japanese
 IC ICM C07D307-33
 ICS B01J023-40; B01J031-08
 ICA C07B061-00
 CC 27-6 (Heterocyclic Compounds (One Hetero Atom))
 FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|--------------------|------|----------|-----------------|-------------|
| PI JP 05255296 | A2 | 19931005 | JP 1992-87573 | 19920312 <- |
| PRAI JP 1992-87573 | | 19920312 | <- | |

 CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|-------------|--|--|
| JP 05255296 | ICM ICS ICA | C07D307-33 B01J023-40; B01J031-08 C07B061-00 |
| OS | CASREACT 120:134267 | |
| AB | Lactones are prepared by hydrogenation of saturated and/or unsatd. dicarboxylic acid derivs., e.g. succinic acid and/or maleic acid derivs., in the presence of supported VIII metal catalysts and alkali metal-exchanged organic cation exchangers. Autoclaving a mixture of maleic anhydride, Pd/C, and K-type Amberlyst 16 in dimethoxyethane under 50 kg/cm ² -gage H at 120.degree. for 16 h gave 68.7 mol% .gamma.-butyrolactone. | |
| ST | palladium catalyst hydrogenation maleic anhydride; succinic anhydride hydrogenation; lactone prepn; butyrolactone prepn; noble metal catalyst hydrogenation maleate; cation exchanger hydrogenation maleic anhydride | |
| IT | Platinum-group metals RL: CAT (Catalyst use); USES (Uses) (catalysts, supported, for hydrogenation of (un)saturated dicarboxylates, lactones from) | |
| IT | Alkali metals, uses RL: USES (Uses) (cation exchangers exchanged with, in hydrogenateion of (un)saturated dicarboxylates, lactones from) | |
| IT | Hydrogenation (of (un)saturated dicarboxylates, lactones from) | |
| IT | Hydrogenation catalysts (platinum-group metals, supported, for (un)saturated dicarboxylates to lactones) | |
| IT | Lactones RL: SPN (Synthetic preparation); PREP (Preparation) (preparation of, by hydrogenation of (un)saturated dicarboxylates) | |
| IT | Carboxylic acids, reactions RL: RCT (Reactant); RACT (Reactant or reagent) (di-, unsatd., hydrogenation of, lactones from, platinum group-metal catalysts for) | |
| IT | Polyoxalkylenes, uses RL: USES (Uses) (fluorine- and sulfo-containing, ionomers, alkali metal-exchanged, in hydrogenation of (un)saturated dicarboxylates, lactones from) | |
| IT | Fluoropolymers RL: RCT (Reactant); RACT (Reactant or reagent) (polyoxalkylene-, sulfo-containing, ionomers, alkali metal-exchanged, in hydrogenation of (un)saturated dicarboxylates, lactones from) | |
| IT | 9002-29-3, IRC 50 125004-35-5, Amberlyst 16 RL: RCT (Reactant); RACT (Reactant or reagent) (alkali metal-exchanged, in hydrogenation of (un)saturated dicarboxylates, lactones from) | |
| IT | 7440-05-3, Palladium, uses RL: CAT (Catalyst use); USES (Uses) (catalyst, supported, for hydrogenation of (un)saturated dicarboxylates, lactones from) | |
| IT | 7440-09-7, Potassium, reactions 7440-17-7, Rubidium, reactions 7440-23-5, Sodium, reactions 7440-46-2, Cesium, reactions RL: RCT (Reactant); RACT (Reactant or reagent) (cation exchangers exchanged with, in hydrogenateion of (un)saturated dicarboxylates, lactones from) | |
| IT | 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions RL: RCT (Reactant); RACT (Reactant or reagent) (hydrogenation of, butyrolactone from, platinum group-metal catalysts for) | |
| IT | 1333-74-0 RL: RCT (Reactant); RACT (Reactant or reagent) (hydrogenation, of (un)saturated dicarboxylates, lactones from) | |
| IT | 96-48-0P, .gamma.-Butyrolactone RL: SPN (Synthetic preparation); PREP (Preparation) (preparation of, by hydrogenation of (un)saturated dicarboxylate) | |

L50 ANSWER 18 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
 AN 1993:580641 HCAPLUS
 DN 119:180641
 ED Entered STN: 30 Oct 1993
 TI Preparation of lactones by hydrogenation of dicarboxylic acids
 IN Fuchigami, Takamasa; Wakasa, Noriko; Ga, Tokuka; Sasakihara, Hiroyuki;

PA Kano, Yoshiaki; Saito, Toshihiro
 PA Tosoh Corp, Japan; Sagami Chem Res
 SO Jpn. Kokai Tokkyo Koho, 6 pp.
 CODEN: JKXXAF
 DT Patent
 LA Japanese
 IC ICM C07D307-33
 ICS B01J029-06
 ICA C07B061-00
 CC 27-6 (Heterocyclic Compounds (One Hetero Atom))
 FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---------------------|------|----------|-----------------|--------------|
| PI JP 05148253 | A2 | 19930615 | JP 1991-337983 | 19911128 <-- |
| PRAI JP 1991-337983 | | 19911128 | <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
|------------|-------|------------------------------------|

| | | |
|-------------|-----|------------|
| JP 05148253 | ICM | C07D307-33 |
| | ICS | B01J029-06 |
| | ICA | C07B061-00 |

OS CASREACT 119:180641

AB Lactones (such as .gamma.-butyrolactone) are prepared by hydrogenation of saturated and/or unsatd. dicarboxylic acids (such as succinic acid and/or maleic acid) in the presence of supported group VIII noble metal catalysts and alkali zeolites. Autoclaving a mixture of maleic acid, 5% Pd/C, Mol. Sieve 3A (K-type A zeolite), and dimethoxyethane under 50 kg/cm²-gage H at 180.degree. for 16 h gave 99% .gamma.-butyrolactone.

ST gamma butyrolactone prep; hydrogenation dicarboxylate catalyst noble metal; alkali zeolite hydrogenation dicarboxylate; lactone prep

IT Platinum-group metals

RL: CAT (Catalyst use); USES (Uses)
(catalysts, for hydrogenation of dicarboxylates, lactones from)

IT Hydrogenation

(of dicarboxylates, lactones from, alkali zeolites in)

IT Hydrogenation catalysts

(platinum-group metals, for dicarboxylates, lactones from)

IT Lactones

RL: SPN (Synthetic preparation); PREP (Preparation)
(preparation of, by hydrogenation of dicarboxylates, catalysts and additives in)

IT Zeolites, uses

RL: USES (Uses)
(K mordenite-type, in hydrogenation of dicarboxylate, lactones from)

IT Zeolites, uses

RL: USES (Uses)
(alkali metal, in hydrogenation of dicarboxylates, lactones from)

IT Carboxylic acids, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(di-, hydrogenation of, lactones from, catalysts and additives in)

IT Zeolites, uses

RL: USES (Uses)
(ferrierite-type, in hydrogenation of dicarboxylate, lactones from)

IT 7440-05-3, Palladium, uses

RL: CAT (Catalyst use); USES (Uses)
(catalyst, for hydrogenation of dicarboxylates, lactones from)

IT 110-15-6, Succinic acid, reactions

110-16-7, Maleic acid, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation of, butyrolactone from, catalysts and additives in)

IT 1333-74-0

RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation, of dicarboxylates, lactones from, alkali zeolites in)

IT 96-48-0P, .gamma.-Butyrolactone

RL: SPN (Synthetic preparation); PREP (Preparation)
(preparation of, by hydrogenation of maleic acid or succinic acid)

L50 ANSWER 19 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN

AN 1988:551948 HCPLUS

DN 109:151948

ED Entered STN: 28 Oct 1988

TI Catalysts and process for manufacture of butanediols and butyrolactones by hydrogenation and ring closure of dicarboxylic acids

IN Rao, Velliur Nott Mallikarjuna

PA du Pont de Nemours, E. I., and Co., USA

SO Eur. Pat. Appl., 5 pp.

CODEN: EPXXDW

DT Patent

LA English

IC ICM C07D307-32

ICS C07C029-136; C07C029-17

CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)
Section cross-reference(s): 27, 67

FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|----|---|---------------|--|-------------------------------|------------------------------|
| PI | EP 276012 | A2 | 19880727 | EP 1988-100922 | 19880122 <-- |
| | EP 276012 | A3 | 19880817 | | |
| | EP 276012 | B1 | 19920506 | | |
| | R: DE, FR, GB, NL US 4782167 JP 63218636 JP 2744428 PRAI US 1987-6239 | A A2 B2 | 19881101 19880912 19980428 19870123 | US 1987-6239 JP 1988-12430 | 19870123 <-- 19880122 <-- |

CLASS

PATENT NO. CLASS PATENT FAMILY CLASSIFICATION CODES

| | | |
|-----------|-----|-------------------------|
| EP 276012 | ICM | C07D307-32 |
| | ICS | C07C029-136; C07C029-17 |

OS CASREACT 109:151948

AB Butyrolactones and butanediols are prepared by hydrogenating a dicarboxylic acid precursor in the presence of an aqueous reaction medium and a catalyst comprising Pd and optionally Re on a support selected from the oxides of Ti, Zr, and Hf. A solution of 5% succinic acid and 2% dioxane in water was passed at 22.4 mL/h through a fixed bed catalyst containing 4.12 g of 1% Pd and 4% Re on TiO₂ with 50 mL/min H flow rate. The cyclization was conducted at 200.degree./3.5 MPa, resulting in 100.00% succinic acid conversion, with selectivity to THF 1.74, .gamma.-butyrolactone 90.32, and 1,4-butanediol 7.94%.

ST butyrolactone butanediol manuf hydrogenation succinate; palladium rhenium catalyst butyrolactone manuf

IT Ring closure and formation
(of dicarboxylic acids during hydrogenation, manufacture of butyrolactones by)

IT Hydrogenation
(of dicarboxylic acids, butanediols and butyrolactone manufacture by)

IT Hydrogenation catalysts
(palladium-rhenium, for manufacture of butyrolactones and butanediols from dicarboxylic acids)

IT Carboxylic acids, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(di-, hydrogenation and ring closure of, manufacture of butyrolactones and butanediols from)

IT 7440-15-5, Rhenium, uses and miscellaneous

RL: CAT (Catalyst use); USES (Uses)
(catalysts, containing palladium, for hydrogenation and ring closure of dicarboxylic acids)

IT 7440-05-3, Palladium, uses and miscellaneous

RL: CAT (Catalyst use); USES (Uses)
(catalysts, containing rhenium, for hydrogenation and ring closure of dicarboxylic acids)

IT 110-17-8, Fumaric acid, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation and ring closure of, butanediols and butyrolactones from)

IT 110-15-6, Succinic acid, reactions

110-16-7, Maleic acid, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation and ring closure of, butyrolactone and butanediol from, catalysts for)

IT 97-65-4, Itaconic acid, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation and ring closure of, methylbutyrolactone and methylbutanediol from, catalysts for)

IT 1333-74-0
 RL: USES (Uses)
 (hydrogenation, of dicarboxylic acids, butanediols and
 butyrolactone manufacture by)
 IT 1314-23-4, Zirconia, uses and miscellaneous 13463-67-7, Titanium
 dioxide, uses and miscellaneous 37230-85-6
 RL: USES (Uses)
 (supports, for palladium and rhenium hydrogenation and ring closure
 catalysts)

L50 ANSWER 20 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1988:55882 HCPLUS
 DN 108:55882
 ED Entered STN: 20 Feb 1988
 TI Preparation of .gamma.-butyrolactone by hydrogenation
 of maleic or succinic acid or anhydride
 IN Wada, Hirosuke; Otake, Masayuki; Ushikubo, Takashi; Mori, Tomoyuki
 PA Mitsubishi Chemical Industries Co., Ltd., Japan
 SO Jpn. Kokai Tokkyo Koho, 8 pp.
 CODEN: JKXXAF
 DT Patent
 LA Japanese
 IC ICM C07D307-32
 ICS B01J023-89
 CC 27-7 (Heterocyclic Compounds (One Hetero Atom))
 FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---------------------|-------|----------|-----------------|--------------|
| ----- | ----- | ----- | ----- | ----- |
| PI JP 62111974 | A2 | 19870522 | JP 1985-251020 | 19851110 <-- |
| PRAI JP 1985-251020 | | 19851110 | <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|-------------|-------|------------------------------------|
| ----- | ----- | ----- |
| JP 62111974 | ICM | C07D307-32 |
| | ICS | B01J023-89 |

AB .gamma.-Butyrolactone (I) is prepared by hydrogenation
 of maleic acid, succinic acid, or
 their anhydrides in the presence of a 1-6:5-50 (weight%) Pd-Co/Kieselguhr
 solid hydrogenation catalyst. A Pd-Co [2.1:20.8 (weight%)] catalyst
 impregnated on powdered Kieselguhr (size >250 .mu.) (3 g) was applied to
 hydrogenation of 30 g maleic anhydride (II) in 30 g I as a solvent at
 80.degree. and 50 kg/cm² H for 1 h and then 250.degree. and 100 kg/cm² H
 for 2 h to give 72.7% I based on II.

ST butyrolactone; maleic acid deriv
 hydrogenation; succinic acid deriv hydrogenation;
 palladium cobalt hydrogenation catalyst

IT Hydrogenation
 (of maleic or succinic acids or anhydrides,
 .gamma.-butyrolactone from)

IT Hydrogenation catalysts
 (palladium-cobalt on Kieselguhr, for maleic or succinic
 acids or anhydrides)

IT 108-30-5, Succinic anhydride, reactions 108-31-6, Maleic anhydride,
 reactions 110-15-6, Succinic acid, reactions
 110-16-7, Maleic acid, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation of, in presence of palladium and cobalt, .gamma.-
 butyrolactone from)

IT 1333-74-0
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation, of maleic or succinic acids or
 anhydrides, .gamma.-butyrolactone from)

IT 96-48-0P, .gamma.-Butyrolactone
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of maleic or succinic
 acids or anhydrides)

L50 ANSWER 21 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1987:137661 HCPLUS
 DN 106:137661
 ED Entered STN: 01 May 1987
 TI Hydrogenation of organic carbonyl compounds
 IN Wada, Hirosuke; Shima, Kenji
 PA Mitsubishi Chemical Industries Co., Ltd., Japan
 SO Jpn. Kokai Tokkyo Koho, 6 pp.
 CODEN: JKXXAF

DT Patent
 LA Japanese
 IC ICM C07C027-04
 ICS B01J031-20; B01J031-24; B01J031-32; C07C029-136; C07C031-08;
 C07C033-22; C07C069-14; C07C069-78
 CC 21-2 (General Organic Chemistry)
 FAN.CNT 1

| PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|--------------------|------|----------|-----------------|--------------|
| PI JP 61243033 | A2 | 19861029 | JP 1985-83319 | 19850418 <-- |
| PRAI JP 1985-83319 | | 19850418 | <-- | |

CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|-------------|-------|--|
| JP 61243033 | ICM | C07C027-04 |
| | ICS | B01J031-20; B01J031-24; B01J031-32; C07C029-136; C07C031-08; C07C033-22; C07C069-14; C07C069-78 |

AB Carboxylic acids, carboxylic anhydrides, and carboxylic esters were hydrogenated in the presence of Re (compds.) and organic amines as catalysts. Thus, 50 mmol AcOH was autoclaved 2 h in the presence of 0.1 mmol ReOCl₃(PPh₃)₂ and 1.0 mmol n-Bu₃N to give 1.1% EtOH and 9.0% AcOEt.

ST carbonyl compd hydrogenation catalyst

IT Hydrogenation
 (of carbonyl compds.)

IT Hydrogenation catalysts
 (rhenium compds., for carbonyl compds.)

IT 141-78-6, Ethyl acetate, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (byproduct, from hydrogenation of acetic acid)

IT 120-51-4, Benzyl benzoate
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (byproduct, from hydrogenation of benzoic acid)

IT 1314-28-9, Rhenium trioxide 12060-05-8 13569-63-6 17442-18-1
 RL: CAT (Catalyst use); USES (Uses)
 (catalyst, for hydrogenation of carbonyl compds.)

IT 64-19-7, Acetic acid, reactions 65-85-0, Benzoic acid, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation of, alc. and ester from)

IT 93-58-3, Methyl benzoate
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation of, benzyl alc. from)

IT 108-30-5, Succinic anhydride, reactions 110-15-6,
 Succinic acid, reactions 110-16-7,
 Maleic acid, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation of, butyrolactone and THF from)

IT 1333-74-0
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation, of carbonyl compds.)

IT 100-51-6P, Benzyl alcohol, preparation
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of Me benzoate or benzoic acid)

IT 64-17-5P, Ethanol, preparation
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of acetic acid)

IT 96-48-0P, .gamma.-Butyrolactone
 109-99-9P, Tetrahydrofuran, preparation
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of succinic anhydride or succinic acid or maleic acid)

L50 ANSWER 22 OF 23 HCPLUS COPYRIGHT 2004 ACS on STN
 AN 1980:549734 HCPLUS
 DN 93:149734
 ED Entered STN: 12 May 1984
 TI Homogeneous catalytic hydrogenation of free carboxylic acids in the presence of cluster ruthenium carbonyl hydrides
 AU Bianchi, Mario; Menchi, Gloria; Francalanci, Franco; Piacenti, Franco;
 Matteoli, Ugo; Frediani, Piero; Botteghi, Carlo
 CS Univ. Florence, Florence, 50121, Italy
 SO Journal of Organometallic Chemistry (1980), 188(1), 109-19
 CODEN: JORCAI; ISSN: 0022-328X
 DT Journal
 LA English
 CC 23-16 (Aliphatic Compounds)
 AB Saturated monocarboxylic acids up to C6, several dicarboxylic acids, and some

of the corresponding anhydrides are hydrogenated in the homogeneous phase over H4Ru4(CO)8(PBu3)4 to give the corresponding alcs. (present among the reaction products as esters) or lactones at 100-200.degree./ 100-200 atm H. Anhydrides react at temps. lower than those needed for acids. Esters are not reduced. Only .delta.-valerolactone is hydrogenated to 1,5-pentanediol. Ru carbonyl carboxylates recovered at the end of the reaction, are catalytically active intermediates.

ST carboxylic acid hydrogenation ruthenium; anhydride hydrogenation ruthenium carbonyl

IT Anhydrides
Carboxylic acids, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation of, ruthenium carbonyl hydride catalysts for)

IT Hydrogenation
(of carboxylic acids, alcs. and lactones from)

IT Hydrogenation catalysts
(ruthenium carbonyl hydride, for carboxylic acids and anhydrides)

IT Carbynols
RL: RCT (Reactant); RACT (Reactant or reagent)
(ruthenium hydrides, catalysts, for hydrogenation of carboxylic acids and anhydrides)

IT 141-82-2, reactions 144-62-7, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(attempted hydrogenation of)

IT 34742-78-4
RL: CAT (Catalyst use); USES (Uses)
(catalyst, for hydrogenation of carboxylic acid)

IT 34742-81-9 65899-42-5
RL: CAT (Catalyst use); USES (Uses)
(catalyst, for hydrogenation of cyclohexanone)

IT 34742-77-3
RL: CAT (Catalyst use); USES (Uses)
(catalyst, for hydrogenation of cyclohexanone or acetic acid)

IT 34438-91-0
RL: CAT (Catalyst use); USES (Uses)
(catalyst, for hydrogenation of cyclohexene or cyclohexanone)

IT 34802-75-0
RL: CAT (Catalyst use); USES (Uses)
(catalyst, for hydrogenation of cyclohexene, cyclohexanone or acetic acid)

IT 64-18-6, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(decomposition of, in presence of ruthenium carbonyl hydride catalyst)

IT 65-85-0, reactions 85-44-9 88-99-3, reactions 103-82-2, reactions 106-31-0 107-92-6, reactions 110-17-8, reactions 124-04-9, reactions 1121-34-2 1724-02-3 6915-15-7
RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation of, in presence of ruthenium carbonyl hydride catalyst)

IT 64-19-7, reactions 79-09-4, reactions 79-31-2 107-92-6, reactions 108-24-7 108-30-5, reactions 108-94-1, reactions 109-52-4, reactions 110-15-6, reactions 110-83-8, reactions 116-53-0 123-62-6 142-62-1, reactions 498-21-5 503-74-2
RL: RCT (Reactant); RACT (Reactant or reagent)
(hydrogenation of, ruthenium carbonyl hydride catalyst for)

IT 694-54-2P
RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)
(preparation and hydrogenation of)

IT 78-83-1P, preparation
RL: SPN (Synthetic preparation); PREP (Preparation)
(preparation of)

IT 105-60-2P, preparation
RL: SPN (Synthetic preparation); PREP (Preparation)
(preparation of, by hydrogenation of adipic acid in presence of ruthenium carbonyl hydride catalyst)

IT 60-12-8P 100-51-6P, preparation 102-20-5P
RL: SPN (Synthetic preparation); PREP (Preparation)
(preparation of, by hydrogenation of carboxylic acid)

IT 64-17-5P, preparation 71-23-8P, preparation 71-36-3P, preparation 96-48-0P 97-85-8P 106-36-5P 109-21-7P 141-78-6P, preparation 659-70-1P 1679-47-6P 1679-49-8P 2173-56-0P 2445-78-5P 6378-65-0P
RL: SPN (Synthetic preparation); PREP (Preparation)
(preparation of, by hydrogenation of carboxylic acid in presence of ruthenium carbonyl hydride catalyst)

IT 111-29-5P 542-28-9P 74962-45-1P

RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of glutaric acid in presence of ruthenium carbonyl hydride catalyst)

IT 87-41-2P
 RL: SPN (Synthetic preparation); PREP (Preparation)
 (preparation of, by hydrogenation of phthalic acid anhydride in presence of ruthenium carbonyl hydride catalyst)

L50 ANSWER 23 OF 23 HCAPLUS COPYRIGHT 2004 ACS on STN
 AN 1970:470210 HCAPLUS
 DN 73:70210
 ED Entered STN: 12 May 1984
 TI Hydrogenation of maleic anhydride and intermediates by nickel-rhenium catalyst supported on kieselguhr
 AU Kanetaka, Junichi; Kiryu, Seiichi; Asano, Taisuke; Masamune, Shinobu
 CS Cent. Res. Lab., Mitsubishi Petrochem. Co. Ltd., Ibaragi, Japan
 SO Bulletin of the Japan Petroleum Institute (1970), 12, 89-96
 CODEN: BUJPAS; ISSN: 0582-4656
 DT Journal
 LA English
 CC 67 (Catalysis and Reaction Kinetics)
 AB A kinetic study of the hydrogenation of maleic anhydride and intermediates in which a Ni-Re catalyst supported on kieselguhr was used has been carried out in order to investigate the activity of this catalyst on each reaction step and its effect on the reaction mechanism. This catalyst not only resists corrosion by the organic acids such as maleic acid, succinic acid, propionic acid, and butyric acid under the co-existence of water, but also directly promotes hydrogenation of maleic anhydride to THF. The kinetic studies were done for each of the reaction steps involved in this process, and the orders and the rate of consts. of these reaction steps were obtained. Especially, from the kinetic study of hydrogenation of succinic anhydride to gamma.-butyrolactone it is clearly noted that succinic acid and water are the strong inhibitors. There are three main reaction paths in this process as follows: via gamma.-butyrolactone > via polyester .mchgt. via succinic acid.
 ST maleic anhydride hydrogenation catalysis; hydrogenation maleic anhydride catalysis; nickel rhenium catalyst; rhenium nickel catalyst; kieselguhr catalyst support; THF prodn catalysis
 IT Kieselguhr
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts, for hydrogenation of maleic anhydride to tetrahydrofuran)
 IT Hydrogenation catalysts
 (nickel-rhenium, for maleic anhydride in tetrahydrofuran manufacture)
 IT Kinetics of hydrogenation
 (of maleic anhydride and intermediates, in preparation of tetrahydrofuran)
 IT Activation energy of hydrogenation
 (of maleic anhydride and intermediates, on nickel-rhenium catalysts)
 IT Hydrogenation
 (of maleic anhydride, to tetrahydrofuran)
 IT 7440-02-0, uses and miscellaneous 7440-15-5, uses and miscellaneous
 RL: CAT (Catalyst use); USES (Uses)
 (catalysts, for hydrogenation of maleic anhydride to tetrahydrofuran)
 IT 109-99-9P, preparation
 RL: PREP (Preparation)
 (from maleic anhydride, catalysts for)
 IT 25777-14-4
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrocracking of, in catalytic formation of tetrahydrofuran)
 IT 96-48-0 108-30-5 108-31-6, reactions 110-15-6,
 reactions 110-63-4, reactions
 RL: RCT (Reactant); RACT (Reactant or reagent)
 (hydrogenation of, catalysts for)
 IT 26247-20-1P
 RL: PREP (Preparation)
 (preparation of)

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